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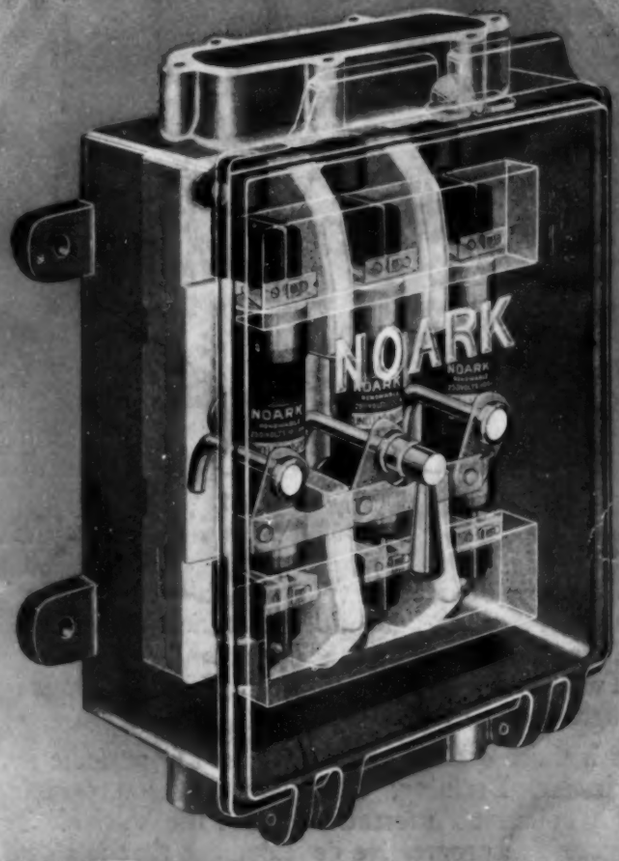

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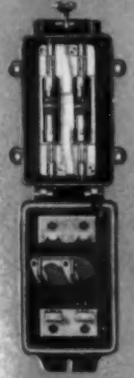

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CHEMICAL & METALLURGICAL ENGINEERING

VOLUME THIRTY-SIX - NUMBER TWO

FEBRUARY, 1929

Liquid Phase Operation of Sulphuric Acid Chambers Gains Significance in Europe 68

PERCY PARRISH, chemical engineer of London, England, shows how the Gaillard-Parrish system makes possible the production of chamber acid with low space-time relations, at practically no increase in nitric acid consumption.

High Lights in Electrifying a Powder Mill 79

FRED L. A. SCHMIDT describes the precautions taken in electrifying the plant of the Austin Powder Company, Falls Junction, Ohio.

What Constitutes Invention? 83

LOUIS BURGESS, now a patent attorney in New York but formerly in development work for the Standard Oil Company of N. J., is well qualified to show engineers their true status in the hazy field of invention.

Estimating Heat Consumed in Batch Rectification of Alcohol 89

GLEN S. HOUGHLAND indicates the calculations to be followed in intermittent distillation of solutions of variable composition.

Constituents of Value Added by Manufacture 82

S. B. LADD, of Washington, presents an analysis of statistics on commodity values as represented by the various contributing factors.

Brief History of the Spray Cooling of Water 81

B. R. T. COLLINS, Sprayco, Inc., Boston

New Alkali Plant for Pacific Northwest 88

Editorials 65

Readers' Views and Comments 95

Chemical Engineers' Bookshelf 97

Selections from Recent Literature 101

Government Publications 102

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Searchlight Section 199
Professional Directory ..208
Ready Reference 210
Advertisers' Index 218

Unusual Facilities for Unit Operations on a Semi-Works Scale 73

R. S. McBRIDE has visited the Minnesota School of Mines Experiment Station to describe the suggestive features of semi-works practice there.

Titanium Offers New Possibilities as a Pigment 76

A. W. HIXSON and W. W. PLECHNER, of the chemical engineering department at Columbia University, show why titanium promises to come to the fore in the present time of exacting paint specifications.

Improving Fractionation for Cracking Processes 78

D. B. KEYES, of the University of Illinois, gives two improved arrangements that may be applied to the Dubbs and Holmes-Manley process.

Surface Films Protect Metals Against Corrosion 85

F. N. SPELLER, prominent authority in the study of corrosion, reviews, in his paper before the American Association for the Advancement of Science, the surface phenomena that modify corrosion.

Providing for Patent Obsolescence in Chemical Industry 92

F. P. BYERLY, of the firm of Price, Waterhouse & Company, Philadelphia, clarifies the growing question of processes and patents as major factors in industry.

The Plant Notebook 103

Curves for Oil Calculations
BY L. G. JONES

Eliminating Chemical Mist
BY V. ZACHERT

Equipment News 105

Manufacturers' Publications 109

Patents Issued, Jan. 1 to 29 110

News of the Industry 112

Personals and Obituary 118

Industrial Notes 119

Market Conditions and Price Trends 120

Industrial Developments 127

How Colgate-Palmolive-Peet Company (EDIBLE PRODUCTS DEPARTMENT) *Assures the Safe, Clean Shipment of* Cocoanut Oil

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VOLUME THIRTY-SIX - NUMBER TWO

FEBRUARY, 1929

S. D. KIRKPATRICK, *Editor*

Self-Regulation of Business Requires Team Work

A NEW DAY in industrial relations was ushered in on January 12 when Charles H. MacDowell appeared before the Commerce Committee of the Senate as a representative consumer and demanded that the bituminous coal industry be given an opportunity to set its own house in order. To be sure, he also appeared as an accredited spokesman for the Chamber of Commerce of the United States which has long stood for business self-regulation, but it is more significant by far to find him, the customer and consumer, standing shoulder to shoulder with the seller and producer in the fight against government interference and government control. We have gone a long way from the time when "there ought to be a law" was the solution passively proposed by an industry for every problem except its own.

MUCH of the success of the Department of Commerce under the secretaryship of Herbert Hoover was due to his introduction of the industry-conference idea. To bring together representatives of an entire industry and to focus their attention on a common problem was always the first and most important step toward its solution. The combined support of these industry groups made possible the initial program for reducing industrial wastes. The co-operative spirit of team work developed through the trade association created the machinery for improving business efficiency by decreasing the costs of production and distribution. The famous Hoover-Donovan correspondence defining legitimate association activities cleared the way for extending the trade-conference system to industry's relations with the regulatory agencies of the Government. It was on such a basis that on January 29 delegates representing more than three-quarters of the entire fertilizer industry met in Washington with the officers of the Federal Trade Commission.

FERTILIZER manufacture now joins the growing group of industries that have been able to make their own rules of conduct with the assurance that the Commission will stand by to give the necessary guidance and enforcement. Unfair trade practices are definitely banned in a group of rules, infraction of which is illegal *per se* and which the Commission itself will enforce by proceeding against clandestine violators. Another group of rules, the violation of which is not in itself illegal, is intended to help the industry to eliminate unsound thinking and uneconomic business methods.

THE bituminous coal industry has yet to find its way to a conference that will rid it of the trade abuses and uneconomic organization that are more or less responsible for its present difficulties. The retail grocery trade, confronted by the common problem of the chain store, held such a conference in Chicago recently and has already launched a constructive program. Other industries more closely allied with the chemical engineering, such as petroleum, paint and varnish and even heavy chemical production, have similar opportunities to follow this obvious path toward the fair solution of their business problems. The new day of constructive prosperity must come from team work that puts industry on a basis of self-regulation and self-government.

Stock Market Appraisal of Chemical Engineering Industry

TECHNICAL success and even real profits are not necessarily measured by Wall Street stock quotations, particularly in the present market. Yet in this appraisal of a company's earning power there is a certain element of value for the guidance even of those whose main concern is the technology and the scientific work of a company. It is with regret, therefore, that chemical engineers constantly see financial houses distributing erroneous information regarding the technical character of industrial enterprises.

Lately there has come to our notice a flagrant example of misinformation about a well-known and long-established chemical engineering enterprise. This statement was issued by a supposedly responsible house whose main business is the advising of would-be investors. This establishment, which boasts of nearly two decades of experience, outlines a report upon the company in question which is so erroneous that it does not correctly name the major products of the corporation or correctly list its principal subsidiaries. Of the more than twenty products listed as produced, approximately half are not made or handled by this corporation. Thus there are wrongly cited the simplest and most readily determinable facts as to the character of the business in which the corporation is engaged.

If this misinformation had been given out regarding certain of the old-fashioned companies with which *Chem. & Met.* is acquainted, we should not be surprised. These companies are so secretive as at times to appear almost averse to stating the names of the commodities which they wish to sell. It happens, however, that the particular corporation referred to here is one that has a very frank and generous policy with the public and with the technical as well as the popular editor.

We do not assume that this corporation suffers seriously in any way from the misdirected energies of this investor "advisor." The case does well illustrate, however, the increasing need which every executive in our industries must sooner or later recognize—that of giving the widest possible public spread to important information regarding his corporation's business and its products. Misinformation is harmful to the entire industrial group.

A Legal Curb on Price Discrimination

NOT since the famous Colgate decision in 1919 and the Mennen and National Biscuit Company cases in 1923 and 1924 has the Supreme Court gone as far in clarifying the Clayton Act as it did in the so-called Van Camp decision rendered on January 2, 1929. It will be recalled that the Colgate case sustained the seller's right to select his own customers while the Mennen and National Biscuit decisions helped to establish the precedent that a manufacturer was justified in charging one price to one branch of an industry, such as the wholesaler, and another price to a different branch, such as the retailer. In the present case, however, we have the clear and unequivocal finding that the seller may not legally sell to a customer if by price discrimination his act tends to create a monopoly or to lessen competition, not in his own industry, but in the field of his customer.

In the suit of George Van Camp & Sons Company *vs.* American Can Company and the Van Camp Packing Company, Inc., it was alleged that the Can Company sold cans to the Packing Company at 20 per cent less than its standard prices and that by special discounts, bonuses and the like, it gave this company an advantage over its competitor, George Van Camp & Sons Company. The suit has been dismissed in the Federal District Court of Indiana for want of equity but on appeal had been certified to the Supreme Court for instructions as to whether or not the Clayton Act applied to price discrimination that lessened competition or tended to create a monopoly in the line of commerce in which the customer is engaged.

Now we have the Supreme Court ruling that Section 2 of the Clayton Act applies to any and all lines of commerce. If the alleged practices in this case can be proved, therefore, they are illegal because in effect they create unfair competition in the canned-goods business. The purchaser discriminated against can bring suit and if successful, can, under the provisions of the Clayton Act, collect triple damages in addition to court costs and attorney fees. Thus, in spite of the fact that Section 2 has never been successfully enforced by any court, the way is opened for vexatious suits against the manufacturer. It is reported that in the present case eight other canning companies have already filed suits totaling $2,225,000.

By this decision the Supreme Court has set up a new ethical standard which must be taken into account in all industries. Reckless price cutting and special discounts not based on quantity or quality considerations, or differences in the cost of selling or transportation, or made in good faith to meet competition—must cease under this decision. It should not be interpreted as compelling a manufacturer to fix absolutely uniform prices but it places a definite ban on unreasonable discrimination between customers when they buy a like kind and quantity of goods. The decision is likely to have far-reaching effect. Industry is fast approaching a time when the old principle of *caveat emptor* will be displaced by a more appropriate warning: "Let the Seller Beware!"

Intra-plant Use of Railway Equipment

RAILWAY companies of the country object to the use of their cars by manufacturers for the movement of goods within the plant. The railroads argue that such practice withdraws cars from transportation service and is an unreasonable drain on the resources of the carriers.

It is reported that the American Railway Association is drafting rules which it will ask the Interstate Commerce Commission to put into effect in order to prevent manufacturing plants from this misuse of railway rolling stock. If such rules take effect many companies will find it necessary to change their practices. It would be worthwhile, therefore, for the transportation officers of corporations whose business may be affected to make a careful analysis of the present situation and determine, in the first place, whether they will oppose the rule if proposed, and secondly, how they will conform with it if adopted. Last minute plans for intra-plant switching may not always be satisfactory, and a far-sighted management will wish to be prepared in so important a matter.

Establishing a Precedent in Natural-Gas Distribution

EUROPEAN critics profess to be much amused by the way American industry "worships the bigger and better." Such amusement appears tinged, however, with an undertone of desire to emulate our phenomenal prosperity. The year just past supplied, among others, another example of "bigger and better" in natural-gas distribution, and word has just been received that at least one record in gas piping is to be established during 1929. The precedents thus created are of interest to chemical engineering industries as consumers as well as producers of fuel.

Last year saw a very considerable amount of trunk line installed for conveying natural gas under pressure to consuming points. The longest of these lines of which we have record covers the 340 miles between Denver and the Amarillo field in Texas. In 1929, however, there is scheduled for completion, a 450-mile line between St. Louis and the Monroe and Richland gas fields in Louisiana. This line, projected by the Mississippi River Fuel Corporation, and expected to be in service before the end of the year, is to supply natural gas to St. Louis for industrial use. Plans now indicate that the line will be provided with five compressor stations, operating at 350 lb. pressure, that it will be constructed of 22-in. welded steel pipe, joined with couplings and that capacity of 1,000-B.t.u. gas will be 100,000,000 cubic feet per day.

What this will mean industrially to St. Louis can only be surmised. One must recall the potent influence which natural gas has exerted in the development of the steel industry in the Pittsburgh district and the glass and chemical industries in the territory surrounding Charleston, W. Va. With a precedent thus established for the long-distance transmission of gas to large industrial centers, it is entirely possible that developments of the next few years will completely dwarf even the Monroe-St. Louis line.

Supreme Court Limits Government Price Regulation

STATE AND FEDERAL regulation of the prices of commodities or services can unquestionably be accomplished under the Constitution of the United States if the commodity or service is "affected with a public interest." The Supreme Court of the United States has repeatedly confirmed this authority. But only lately has it given a clean-cut and conclusive definition of the significant phrase involved.

This important decision came through the findings announced on January 2 in which two of the largest oil companies doing business in Tennessee undertook to prevent the enforcement of a law of that State giving authority for the fixing of prices of gasoline by State officials. The Court says that a state legislature is without power to regulate such prices, even though the public may broadly be interested in the price. It is not sufficient that the business be large or of large public concern. It is essential, if price regulation be legal, that the business or property be such or be so employed that it is *"devoted* to a public use and its use thereby in effect *granted* to the public." The italics used are those employed by the Court itself, making very clear the stress which it places upon the devotion and the granting of the commodity or business to the public.

This decision is of importance because by it the Court clearly intends to estop further effort by public officials to regulate prices of commodities and businesses which are not so clearly set aside. This decision will do much to prevent the demagogue from undertaking to interfere unduly with what is really private business simply because that business happens to be large and to be of interest to the public. The decision places another substantial foundation stone under the present development of self-regulation by industry. It is a decision that will be widely welcomed in all lines of business.

What About Lung Diseases and the Man Who Works in Irritating Gases?

OCCASIONALLY one hears of an ex-service man who has developed pulmonary tuberculosis. "Oh, yes," his neighbors recall, "He was gassed in the war." But did his gassing have anything to do with it? Most recent expert opinion not only arrives at the belief that gassing is not a contributing cause to the development of a tuberculous condition but that there is a likelihood that gassing may act as an actual preventive.

This view is well supported by Col. H. L. Gilchrist, Chief of the Medical Division of the Chemical Warfare Service, in his recently published "Comparative Study of World War Casualties From Gas and Other Weapons." To quote, "The clinical experiences of many who have given this subject thorough study, as well as reports from laboratory experiments, now furnish evidence sufficient to serve the purpose of convincing anyone that pulmonary tuberculosis is not a common effect of gas poisoning and certainly not one of its later effects." The author then goes on to describe numerous experiments of recent date, made on animals, in which the results are negative or indicate an actual protection, small but nevertheless apparent.

Later, he quotes from the Surgeon General's Report of 1920. This shows that, among the troops in France, the tuberculosis rate was 43 per cent higher in 1918 and 75 per cent higher in 1919 for enlisted men in general than it was for those who had been gassed. While perhaps this does not justify belief that gassing in dangerous proportions results in actual protection against pulmonary disease, it certainly presents a strong case for neutral results of gassing.

If therefore, gassing is at least neutral as regards the most virulent of pulmonary diseases, it seems not improbable that lesser afflictions such as influenza are favorably affected. One recalls the chlorine treatments as protection against common colds. Is it entirely a superstition, then, that operators in sulphuric-acid plants and other chemical works where the air is liberally polluted with SO_2, claim immunity to ordinary respiratory affections? In our experience, it is not. Perhaps it is an example of the survival of the fittest, where those who remain have developed a tolerance for both gas and infection. Perhaps it is merely a casehardening of the respiratory tract. In any event, evidence is plentiful that there is a real element of protection in working in atmospheres containing irritating gases. Perhaps, after all, a solution to the enormous economic loss entailed in influenza and common colds may come out of the chemical laboratory or the plant.

Liquid Phase Sulphuric Acid Significance

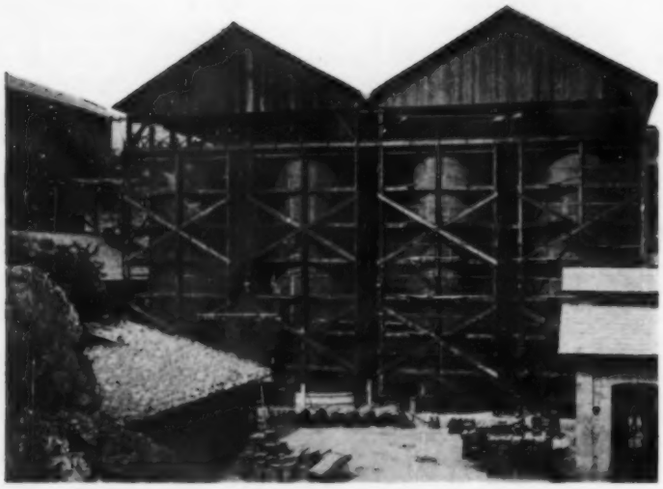


Fig. 1—View of the Gaillard Tower Chambers of the Porto Pi, Majorca, Liquid Phase Plant

Gaillard-Parrish liquid phase system makes possible the production of chamber acid with such low space-time relations

By Percy
Chemical Engineer,

IN A BOOK published by the writer in 1925, on the subject of "Sulphuric Acid Reaction Chambers" (Ernest Benn, Ltd., London), the final chapter was devoted to a consideration of possible future developments. It was remarked that new methods were attracting attention, and that there was a growing tendency at that time to adopt mechanical devices, not only as an aid to intensive working of existing chamber systems, but as an essential apparatus in newly constructed plants. In other words, an attempt was being made to reduce the space-time factor, compatible with steady, uniform and economical operation.

One may well trace the lines along which certain of the efforts have been directed to improve the space-time factor, and examine the question of what form these developments ultimately assumed, and the measure of success that has been achieved.

Following the operation of the bubbler tank, which was the subject of British Patent No. 156,328, it was found that when burner gases containing 4 to 10 per cent of SO_2 were forced through a light seal of nitrous vitriol, which was agitated by known means, the rate at which H_2SO_4 was produced was phenomenally high; indeed, materially in excess of what had been anticipated. It was evident that apart from intimacy of contact between the reacting gases and the catalytic medium, nitrous vitriol, other factors were operating which promoted rapid production.

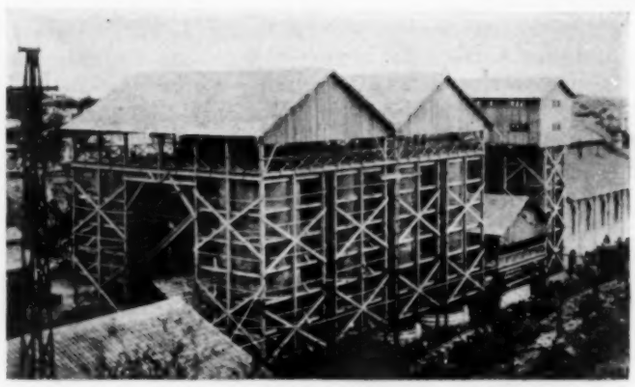


Fig. 2—General View of the Porto Pi, Majorca, Plant

These factors were: (a) Increased rate of absorption of the exothermic heat of reaction; (b) more rapid con-

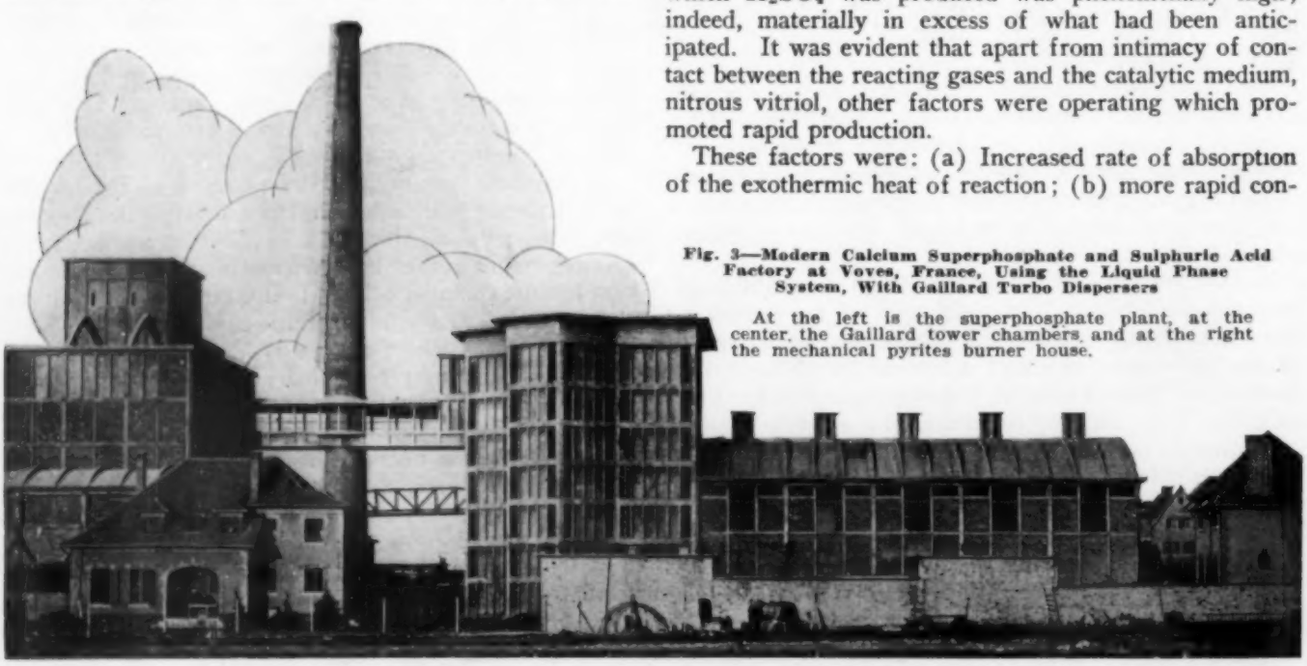


Fig. 3—Modern Calcium Superphosphate and Sulphuric Acid Factory at Voves, France, Using the Liquid Phase System, With Gaillard Turbo Dispersers

At the left is the superphosphate plant, at the center the Gaillard tower chambers and at the right the mechanical pyrites burner house.

Operation of Chambers Gains in Europe

as two cubic feet or less per pound of sulphur per 24 hours, at practically no increase in nitric acid consumption

Parrish
London, England

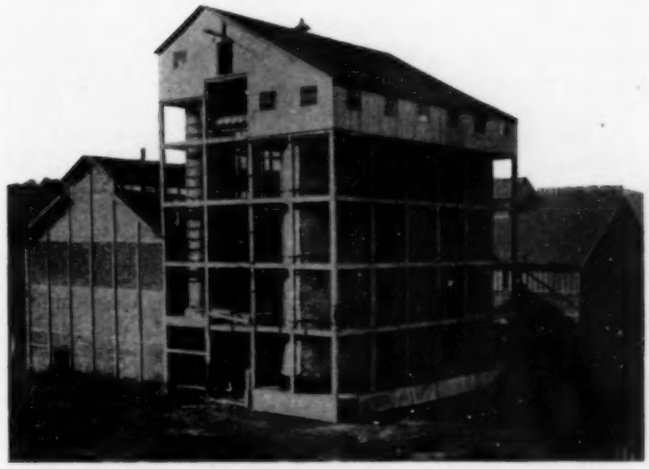


Fig. 7—Modern Sulphuric Acid Plant Using the Liquid Phase System and Gaillard Turbo Dispersers, Erected at La Teleguera (Oviedo)

Fig. 4—Glover and Gay Lussac Towers at San Carlos

densation of acid; and (c) decomposition of nitrosyl sulphate in proportion to its formation.

The bubbler tank, however, possessed one disadvantage in the shape of a high power consumption per unit weight of acid produced, and naturally, means had to be found to overcome this difficulty.

About this time, independent of and unknown to the author, the Spanish engineer, E. A. Gaillard, had appreciated the advantages of reaction under liquid phase conditions as a vital factor in sulphuric acid production, and had developed a peculiarly ingenious device—a turbo disperser—for atomizing sulphuric acid within chambers of various forms.

Curiously enough, the atomization of acid by the device in question admitted of all the advantages of the bubbler box, and involved only a nominal consumption of power. By the rotation of the turbine, aided by an energetic helicoidal movement, cold acid is projected in the form of a very heavy rain against the internal circumference of a tower chamber, or the walls of rectangular or square chambers, thus contributing to very effective cooling. Some of the drops adhere to the lead and fall rapidly, forming a thin film of acid which covers the walls in their entirety, and promotes cooling. The other portion of the drops divides into an infinitely large number of small globules, which rebound and fall, forming a heavy acid fog of a character that almost defies adequate description.

In order to insure perfect irrigation of the walls, the projecting grooves of the turbine have different angles. Some are horizontal; others are more or less inclined above and below the horizontal in such a manner that the

Fig. 5—General View of the San Carlos Plant of la Société Vasco-Andaluza de Abonos

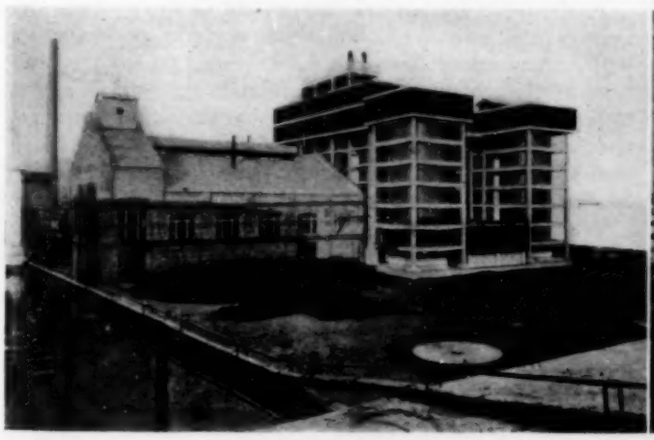


Fig. 6—Position of Turbo Dispersers and Support of the Top of the Gaillard Tower Chambers in the San Carlos Plant

lead walls at different heights receive the projected cold acid. Fig. 8 represents a schematic section of a Gaillard tower chamber, and illustrates how and in what form the atomization of acid is effected.

Semi-technical experiments soon revealed that the atomization of chamber acid, as effected by the Gaillard turbo disperser, of which an illustration is shown in Fig. 9, was distinctly encouraging, and warranted trial on a large scale. One of the first plants erected was at Porto Pi, Majorca, in the Mediterranean. It was capable of producing 50 tons of 53 deg. Bé. acid per day of 24 hours, and consisted of mechanical burners for pyrites, a Glover and two Gay Lussac towers, and eight tower chambers, each of 400 cu.m. (14,116 cu.ft.), capacity.

A view of the towers and a general view of the plant are shown in Figs. 1 and 2. It will be seen that the plant takes the form of a skeleton structure of square pitch-pine posts, mortised to receive suitable cross-members, which are provided with a double tenon, and that cross-bracing is resorted to on the sides and ends, so as to insure a stable and rigid structure.

The operation of this plant not only filled one with sanguine expectations as to its success, but its later working revealed that while the liquid phase principle was a novel one, it was undoubtedly fundamentally sound, and promoted the production of sulphuric acid in a way

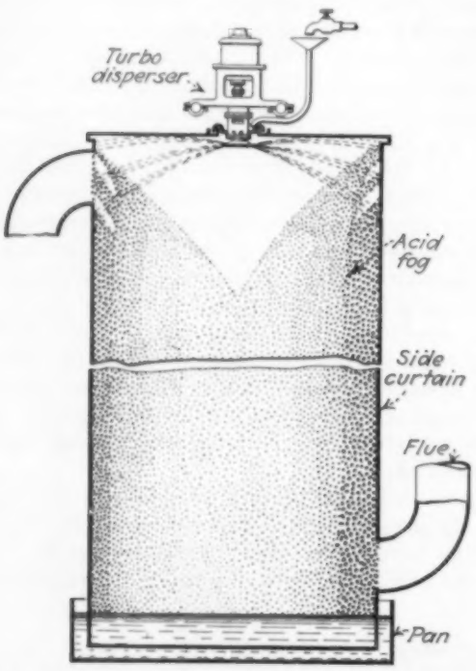


Fig. 8—Schematic Section of Gaillard Tower Chamber

which neither air nor water cooling, however elaborately or efficiently arranged, could achieve.

Since the installation of the Porto Pi acid works, many plants have been erected in Spain, Italy, France, Belgium, Germany, Denmark, England, Australia, New Zealand and India, and naturally, with the cumulative experience that has been amassed, it is not difficult to indicate what form the development of the Gaillard-Parrish liquid phase system has ultimately assumed.

The development has proceeded in three directions. (1) Existing chamber plants have been converted to the liquid phase system; (2) complete new installations of tower chambers have been erected, arranged for operation under liquid phase conditions, in which chamber acid is dispersed; and (3) tower chamber plants have been recently constructed in which provision has been made for the atomization of nitrous vitriol.

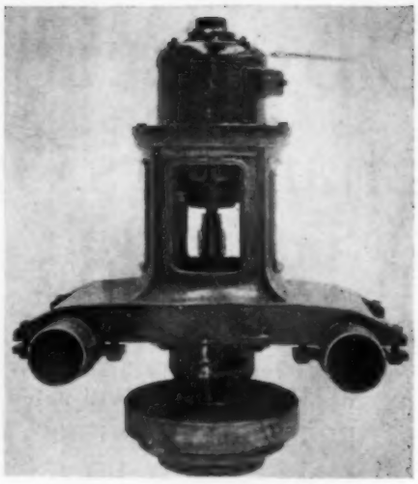


Fig. 9—Gaillard Turbo Disperser

As most of sulphuric acid plants throughout the world have been designed to work under *gaseous phase conditions,* and as many years elapse before complete renewal is effected, naturally, existing installations have afforded the greatest scope for the application of the new principle. There are, therefore, more Gaillard turbo dispersers working in conjunction with rectangular chambers today than in connection with new installations of tower chambers. Meanwhile, on every hand there has been a unanimity of opinion that with a rain of finely atomized acid, which the disperser in question alone insures, not only is there an important increase in the production of acid, but what is equally significant, there is greater regularity in the operation of the plant, and a definite preservation of the leadwork of the chambers.

COST of equipping existing plants to operate intensively by this system is comparatively small, and generally speaking, where the Glover and Gay Lussac towers are adequate in size, an extra production of 25 to 50 per cent can be expected. That the conversion of exist-sulphuric acid units can be effected inexpensively, with facility, and without occasioning any cessation of the operation of the installation, is clearly shown by reference to Figs. 10 and 11. These illustrations speak largely for themselves.

The equipment required, in addition to what is shown in the two illustrations referred to, is a cooler for the acid emerging from (say) the first two chambers and a stock tank. The warm chamber acid of about 50 deg. Bé. should be cooled to (say) 20 deg. C. and then should be pumped to an overhead stock tank and fed in turn to the supply box of the dispersers.

It should be remarked that where Gaillard turbo dispersers are employed, water sprays can be dispensed with. Any water that may be required to aid the reaction in the chambers can be introduced with the acid to be atomized. It is to be noted that the water employed should be free from chlorides, otherwise hydrochloric acid will be formed, which will have an injurious effect on the lead.

Where the rectangular chambers are not housed, as obtains to a large extent in Great Britain, it is customary to provide a poilite (asbestos cement) hut for the turbo disperser, arranged in such a way that there is a circulation of air, so that the motor of the turbo disperser does not become unnecessarily hot.

As to the disposition of the dispersers in the chambers; much depends on local conditions, and on the extent to

which it is desired to increase production. Turbo dispersers should not be applied indiscriminately to existing units of plant. On the other hand, when details are available, not only of the sulphur material used, but of the performance of the plant, the size of the Glover and Gay Lussac towers, and how the plant is draughted, it is easily possible to say what extra duty can be obtained from any plant by the adoption of liquid phase.

An important factor influencing satisfactory operation of the liquid phase system, in connection with rectangular chambers, is the one of height. Obviously, the higher the chamber the greater the productivity of acid. But the adoption of a turbo disperser in connection with the old type of chamber plant adds to the flexibility of the unit very appreciably, and provided continuous records of the working temperatures are kept, and the discharged acid from the chambers is cooled, it can safely be said that an increased production of 25 to 50 per cent can be secured without any appreciable increase in the nitric acid consumption and without any extra deterioration of the lead.

A Danish works has now had turbo dispersers operating for more than four years with eminently satisfactory results. This plant has increased the production of 53 deg. Bé. acid from 10 kg. per cu.m. in 24 hours to 14 kg. per cu.m. in the same period. What this means from the viewpoint of the space-time factor is patent. An increase of 40 per cent cannot be regarded other than as extraordinary. The foregoing result was accompanied by an increased use of nitric acid to the extent of 20 per cent, namely, from 2.5 parts of $NaNO_3$ per 100 parts of sulphur to 3 parts of $NaNO_3$ per 100 parts of sulphur. Comment on this aspect will be made later.

The power consumption for pumping the cooling water and elevating and dispersing the acid to the chambers, per disperser in the installation in question, was 85 kw. per 24 hours. It is easy to compute what the extra cost of operating the liquid phase system represents. The increased production of acid abundantly justifies the additional capital expenditure, and the small increase in the working costs. Incidentally, where the Glover and Gay Lussac towers are adequate in size, there should be no appreciable increase in the nitric acid consumption.

Of course, where practicable, it is expedient to erect a complete new plant. Installations equipped with Gaillard turbo dispersers, and the other necessary accessories, have been erected in many countries including Belgium, France, Italy, Spain, and more recently, Australia.

Where it is proposed to erect a new plant, it is preferable that tower chambers should be installed having a slightly larger diameter at the bottom than at the top. Hitherto it was thought that 7 m. (23 ft.) diameter was the optimum for the disperser in question. Improvements have, however, been effected and practical working over a period has revealed that 10 m. (about 33 ft.) diameter is eminently satisfactory, and that the height can range from 15 m. (50 ft.) to 20 m. (65 ft. 6 in.), according to circumstances. The larger the diameter of a reaction tower chamber, the less the cost of construction in the matter of lead per unit of acid produced.

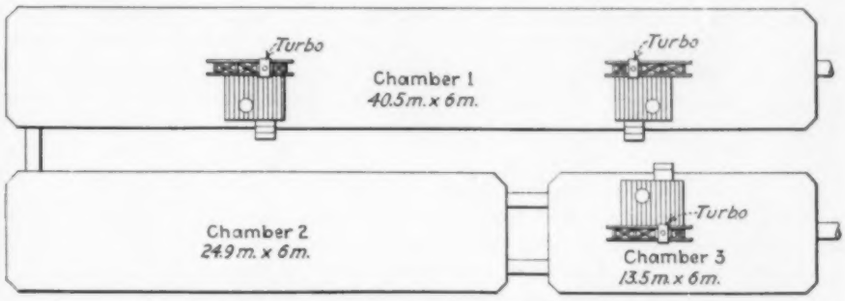


Fig. 11—Plan of Chambers, Showing Location of Dispersers

Where the ground is level it is usual to build the towers on a base about 6 ft. 8 in. high, so as to allow the acid from the tower chambers to pass through coolers, thence to stock tanks and finally to acid pumps which are placed on bases a few inches above ground level.

WHERE the site has a natural inclination, the bases of the tower chambers need only be about 2 ft. high, if they are erected on the higher level. The lower level can easily be arranged for accommodating the coolers, stock tanks and pumps.

A roof is provided for the tower chambers, so that the necessary top storage tanks and their equipment can be installed, and supervision of the operation of the turbo dispersers can be effected in comfort. The circular lead chambers are usually built of 8 lb. chemical sheet lead for the most part, although the top 3 feet should be in the form of a band of 14 lb. lead. It is an easy matter to arrange for the support of the circular leadwork of the tower chambers by lead straps autogenously burned to the circular lead sheets, and these in turn are attached to cross-members placed both at right-angles and diagonally.

Experience has revealed that under practical working conditions it is immaterial whether the dispersed acid travels in the same direction as the gas, or opposite. Where the travel is continuously under conflow conditions it is necessary to bring a flue from the bottom of one tower chamber to the top of the next. With some of the larger chambers, two flues are used. These flues are somewhat expensive to provide; and although they promote vigorous inter-mixing by reason of the turbulence created by the augmented velocity, it has been found that the cost of their erection is unjustified.

In more recent installations, conflow and counterflow have been arranged alternately, by adopting short connecting pipes, either one or two in number, from the respective adjoining chambers, from the bottom in the one case and from the top in the next.

It has also been found advantageous to construct the

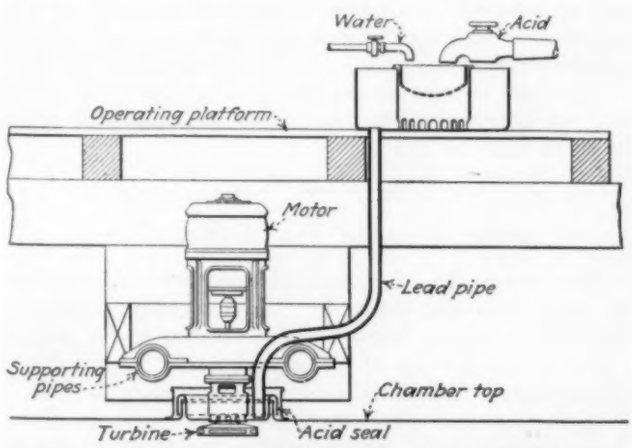


Fig. 10—Gaillard Turbo Disperser Applied to a Standard Rectangular Chamber

Glover towers with a height of 12 m. (say, about 40 ft.). the diameter, of course, varying according to the capacity of the plant. Usually, the height of the packing from the bottom of the pan to the top is 11 m. (36 ft. 6 in.); the remaining portion is lined, but no packing material is used. A mixture of chamber acid and nitrous vitriol is dispersed, and it has been found that denitration is extraordinarily efficient with a tower of this kind.

A general view of a recent installation erected in France is shown in Fig. 3. This factory combines a mechanical pyrites furnace house and a Gaillard tower chamber installation with a superphosphate factory. The whole of the structure is of ferro-concrete, and constitutes a very efficient arrangement. The contour of the tower chamber building, although somewhat unusual, is specially designed to accommodate the plant which is necessary for operation under liquid phase conditions.

ANOTHER typical Gaillard plant is shown in Fig. 7 which represents a unit installed a short time ago at la Telguera (Oviedo, Spain) works of la Sociedad Ibérica del Nitrogeno. This plant comprises: three mechanical burners, each capable of burning 9 tons of pyrites, 48 per cent sulphur, per 24 hours; one void Glover tower 3.9 m. internal diameter and 19 m. high; three tower chambers, 6 m. diameter and 18 m. high; one void Gay Lussac tower, 3.8 m. diameter by 17 m. high; and one final Gay Lussac tower, packed with rings, 3.8 m. diameter by 17 m. high. A fan operates between the first and second Gay Lussac towers. Turbo dispersers are provided for the Glover and void Gay Lussac towers, as well as for the three tower chambers. Although the production of this plant when designed, was regarded as 30,000 kg. of acid of 53 deg. Bé. per 24 hours, this make has been exceeded very considerably.

Still another new factory which has operated with singular success from the start is the one of la Société Vasco-Andaluza de Abonos à San Carlos, near Malaga, Spain, views of which are furnished in Figs. 4 and 5. The skeleton framework of the tower chambers and the Glover and Gay Lussac towers is constructed of reinforced concrete and is indicated in Fig. 4. The position of the turbo dispersers at the top of the tower chambers is shown in Fig. 6. The towers are exposed to the air.

The plant comprises: three mechanical pyrites burners, each with a capacity of 5 to 6 tons (a fourth burner will be installed shortly, in order to increase the production and allow the chamber capacity to be adequately utilized), with a dust chamber of the electrostatic type. The Glover tower is 11 ft. 6 in. diameter by 37 ft. 6 in. high. There are four tower chambers, each 19 ft. 8 in. diameter by 49 ft. 3 in. high, having a total effective capacity of about 1,500 cu.m. (52,930 cu.ft.) The two Gay Lussacs are each 10 ft. 8 in. diameter by 46 ft. high.

The works burns Huelva pyrites containing 49-50 per cent of sulphur. The anticipated production was 15 kg. per cu.m. This performance has been largely exceeded, as is shown by the following results obtained during the 61 days of September and October:—

Average production of 53 deg. Bé. acid	621,885 lb.
Effective capacity of the four tower chambers, representing 2.6 cu. ft. of chamber space per lb. of sulphur per 24 hours	52,930 cu. ft.
Consumption of nitrate of soda per ton of 53 deg. Bé. acid (4.54 kg.)	9.888 lb.

Although the above results exceed the production originally counted upon, it has been determined unmistakably that by the atomization of suitable strengths of nitrous vitriol in the first two tower chambers, the activity of the last two as acid producers was reduced to a negligible quantity The conclusion has been reached that it is possible to work the first two chambers up to an intensity of 40 kg. of 53 deg. Bé. acid per cu.m. per 24 hours.

The foregoing represents the phenomenally low chamber space of 1.75 cu.ft. per lb. of sulphur per 24 hours. Results of this order can be attained with a modern installation without any undue increase of nitric acid consumption, given that the plant is carefully controlled. It is necessary to emphasize that where nitrous vitriol is dispersed, containing N_2O_3 to the extent of (say) 2 to 4 ounces of nitrate of soda per cu.ft. of acid, it is essential that the leadwork of the tower chambers should be protected by acid- and heat-resisting tiles about 6 in. thick, arranged with tongues and grooves so as to give a satisfactory key.

Recently, a large installation has been commenced in Australia, where nitrous vitriol is being dispersed, and the results already are of an eminently satisfactory nature. This plant promises to eclipse all others in point of efficient production with the lowest space-time factor yet known.

That the measure of success achieved by the liquid phase system in the three forms in which it has been applied has been very satisfactory is emphasized by the foregoing citation of results. Every acid manufacturer should find the system worth investigation, since it is not only fundamentally sound, but it challenges all others in regularity of operation, flexibility of control and economical production of sulphuric acid.

Heat Generation in Ball Milling

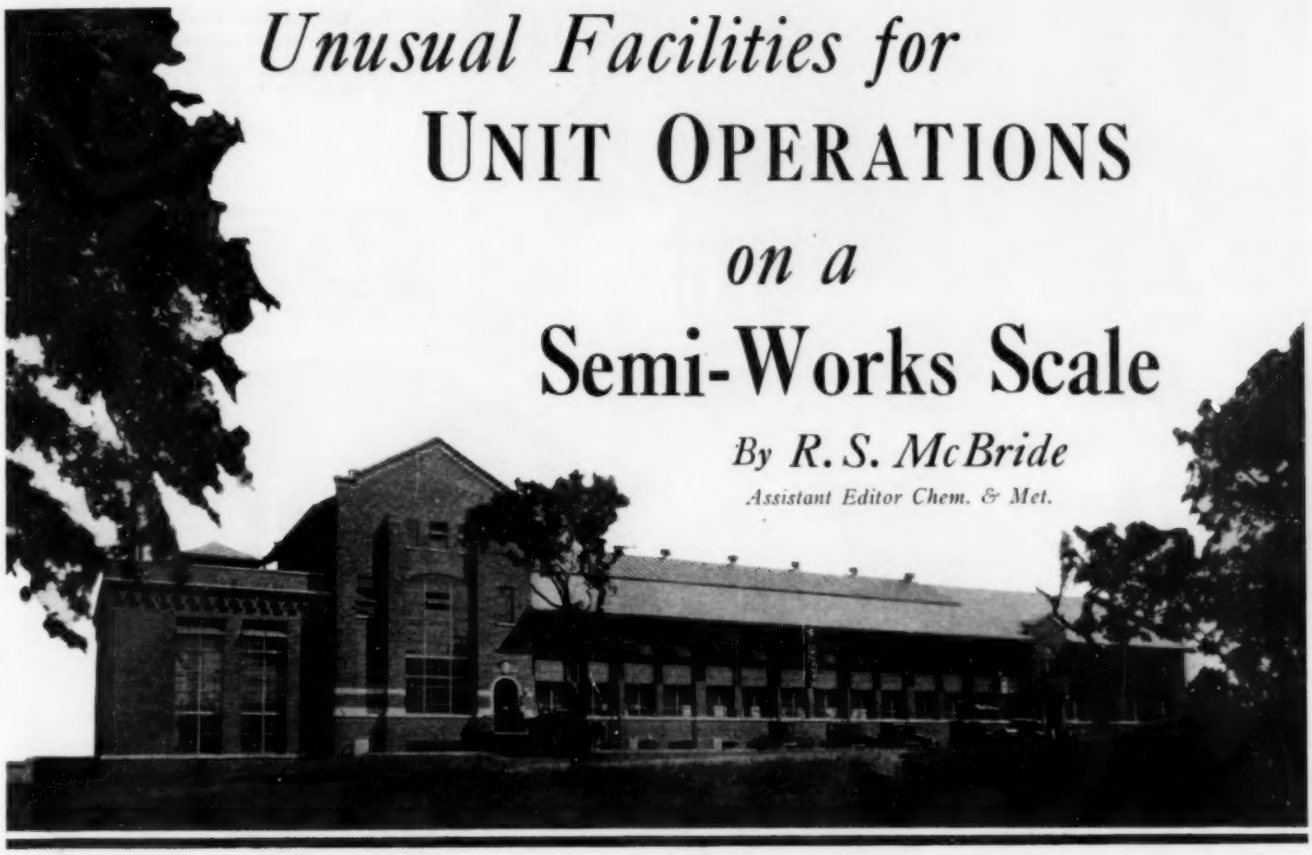
Heat generated in ball milling is the actual consequence of the work done within the mill and is not an indication that energy which should be expended in crushing is being dissipated as heat. This conclusion has been reached in the course of the milling study in progress at the Mississippi Valley experiment station of the Bureau of Mines. A heat study was made of a large commercial ball mill used for wet grinding where the surrounding temperature was about that of the feed and discharge, so that there was little radiation. When the specific heats of the feed and of the water were taken into account the mechanical equivalent of the heat was found to be 125 hp. The motor input was 235 hp. It is believed that these figures give a measure of the relative amount of energy expended within the shell of the mill for crushing. Dead load tests now are being made to check this theory.

Carbon Dioxide Fire Extinguishers

The superiority of carbon dioxide fire extinguishers has been demonstrated by tests in connection with gasoline fires in ship's motor boats, according to the annual report of the Bureau of Construction and Repair, Navy Department. While the first cost is greater the life is longer than that of carbon tetrachloride and 2½-gal. foam extinguishers, which require replacement, it was further brought out.

Unusual Facilities for UNIT OPERATIONS *on a* Semi-Works Scale

By R. S. McBride
Assistant Editor Chem. & Met.



Mines Experiment Station, University of Minnesota. The bin tower is the higher section of the building, with the experimental blast furnace room to the left and general metallurgical laboratory at the right; the offices and chemical laboratories are at the extreme left.

TESTING unit-operation equipment on a semi-works scale is usually difficult, and often impossible because of lack of proper material-handling facilities. Similar restriction on many industrial operations has resulted from lack of adequate facilities for handling of the raw materials and for their preparation in adequate quantity. The engineers of the Minnesota School of Mines Experiment Station recognized the seriousness of these limitations on ore dressing, metallurgical, and other research and determined to provide proper equipment in their new building to eliminate such difficulties. The result has been an exceedingly interesting material-handling installation in what they call the "bin tower" of the University Mines Experiment Station at Minneapolis.

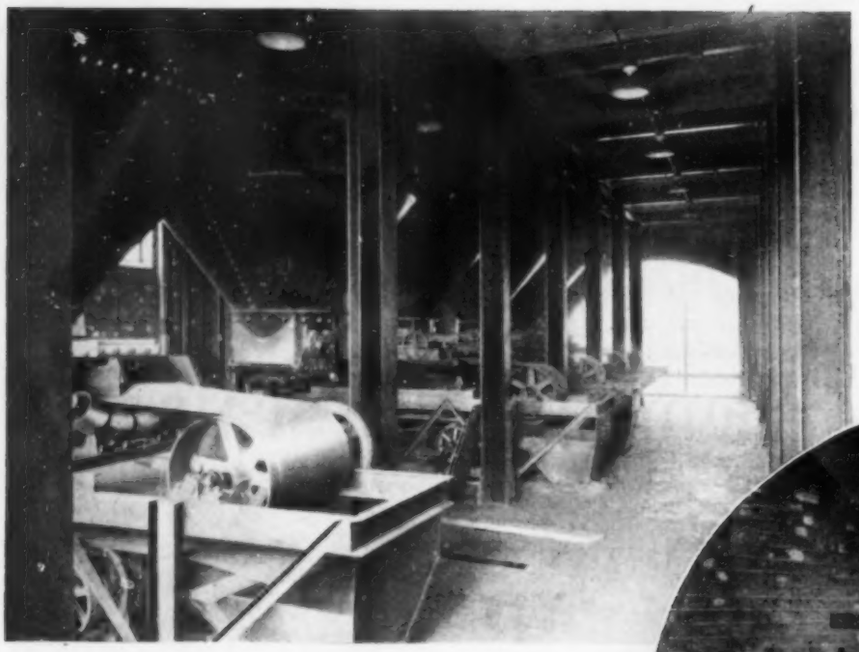
From the general exterior view and the sectional elevation of this portion of the building one can quickly grasp the plan which was developed. It is evident, too, how fully gravity flow has been applied in this installation; the only vertical material handling not so carried out is that of elevation of material from the lowest bins. This operation is carried out in the small storage-battery truck with a tilt-dumping box body which can be utilized for carrying material from point to point on any floor or from incoming tracks and lower floors by means of the ten-ton elevator to the desired upper level of the building.

Most of the material received at the experiment station comes by railroad and can be discharged from the siding immediately adjoining the experimental building onto the out-door platform. From this point it is carried, by the Automatic Transportation Company truck above referred to, to the top floor of the building at which point it can be discharged directly through floor openings into either the ten-ton storage bins for direct use in experimental work or into the seven-ton ore bins for further preparation by grinding, sizing, or otherwise.

These two sets of bins occupy the next to the top floor. The larger ones, two in number, are used primarily for storage of material which is ready for testing in the ore dressing plant which adjoins the bin tower to the east. The six smaller seven-ton ore bins are more frequently used. They discharge onto reversible-belt feeders either to one of the crushing units or one of the vibrating screen units, as desired. Or the discharge may be through a separate hopper to feed the experimental blast furnace which is located in the section of the building next adjoining to the west.

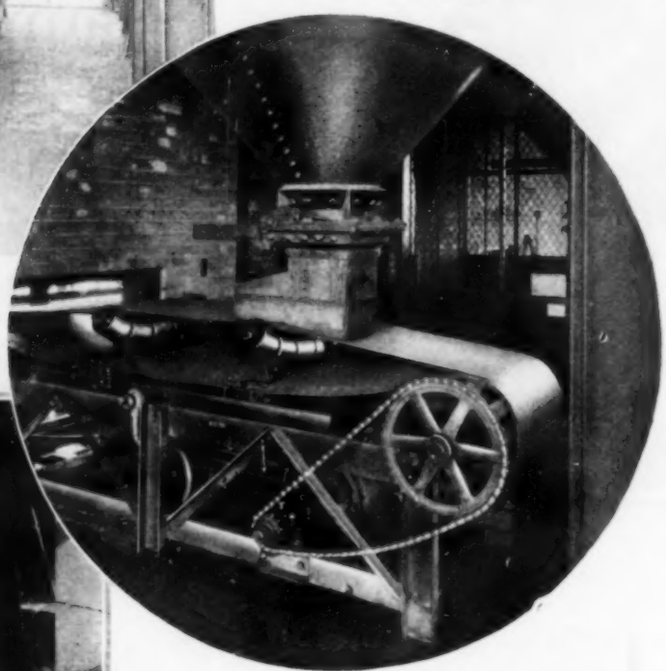
By means of the various crushing units of which there are four now installed and the screening units, of which there are also four, the material as received can be successively subjected to crushing and sizing as desired. The discharge from these crushing and screening units is into the seven-ton ore bins immediately below these unit devices. Hopper discharge into the small electric truck by hand-operated swing gates at the bottom of these bins permits transfer of the partially or completely prepared material again to the upper story either for storage or for further processing.

It is notable that complete flexibility has been provided in this installation. Any succession of sizing and crushing operations can be carried out on a large scale with



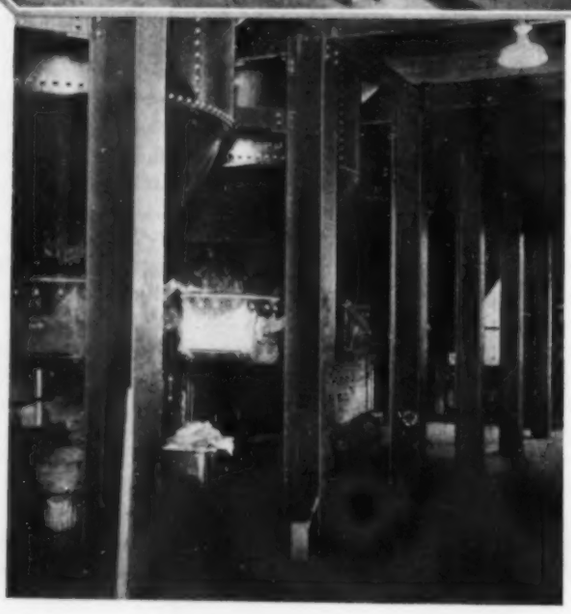
Left—Upper Bin Floor.
Reversible belts are shown with crusher feed hoppers in the foreground; screening feed hoppers at the opposite ends of the reversible belts are not shown here.

Below—Upper Bin Discharge to Laboratory.
This discharge from the ten-ton bin is normally used for finished material which is desired for further experimentation in pyro-metallurgical or hydro-metallurgical studies carried out in the adjoining laboratory.



Below—Crushers.
Four of these units are now in place; space is provided for two additional units in this line. Feed is from the upper storage bins to these crushers and the discharge into the lower storage bins immediately below.

Below—Screening Units.
This group of unit-operation devices is on the same floor level with the crushing units.



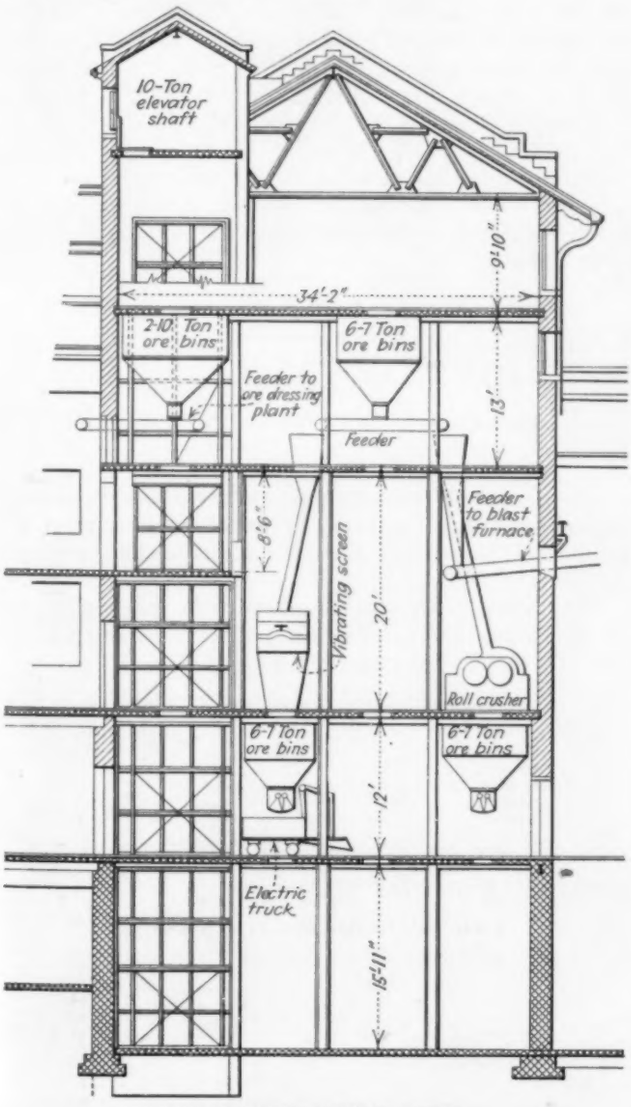
Left—Lower Bin Discharge Floor.
Two rows each of six bins of seven-ton capacity discharge here. Temporary conveying facilities can be installed under these bins to move the material into the laboratory or furnace room adjoining.

practically no manual labor. Hence, any type of rock, ore, or other raw material may be processed into the desired condition very economically.

This material-handling plant has proven invaluable to the staff of the U. S. Bureau of Mines in its work on a miniature blast furnace and in its other metallurgical studies carried out with the facilities used jointly by the federal and state groups. Similarly large advantage has resulted to the state group from having these facilities here for the testing of a wide variety of iron ores which are brought to the University for investigation.

In this work the State of Minnesota has taken the position that anything it can do to facilitate the further utilization of its mineral resources by private interests is more than warranted. In the case of iron ores the state and the university have something of a selfish interest, too. This is because under the state laws a certain depletion tax comes to the state treasury for all of the iron ore developments made in certain parts of the state and in a number of cases the University shares directly in this tax.

The facilities which have here proven so valuable are very suggestive of means which may have equal interest for industrial establishments whose problems are at times necessarily on semi-works scale.



Sectional View of Bin Tower
Relation of unit devices and material-handling equipment is shown approximately to scale.

Fusible Metal Safety Plugs in Chlorine Containers

AT A MEETING of the Committee on Container Specifications of the Chlorine Institute, the Niagara Alkali Company made public its recommendations for control of conditions in the preparation and inserting of the alloy for the fusible metal safety plugs for use in chlorine containers:

In order to control the conditions properly it was decided that all work should be done in our plant and we, therefore, proceed as follows:

1. Purchase the four constituent metals in a pure form. Nothing here should be taken for granted and all metals should be subjected to chemical analysis.
2. Prepare eutectic alloy as follows:
   (a) Use a graphite crucible for the fusion. (This hollowed out of a section of large diameter graphite electrode.) Heating in a gas-fired furnace.
   (b) Put the calculated amount of lead (27.27 per cent) in the crucible and heat until just melted, and then extinguish the heating flame.
   (c) Add the calculated amounts of the other metals in the following order: cadmium, 10.10 per cent; bismuth, 49.50 per cent, and tin 13.13 per cent.
   (d) When the melt is complete, pour into a length of cold angle iron (check composition by chemical analysis.) This is carefully recast later into smaller bars as needed.
3. In filling the bodies of new valves, first drill and tap the channel to be filled and insert an asbestos mandrel in the bottom opening of the valve body. Next place the body on a steam-heated plate and, when thoroughly warmed, swab out the channel with a solution of soldering salts and bring the end of a bar of fusible metal in contact with the valve body at the entrance of the channel. Molten metal will run in almost immediately.
4. After filling the channel and tapping the body lightly, place the outlet nipple of the valve in cold water, taking care not to wet that part of the body containing molten metal. The heat is conducted away from the body very rapidly, and the plug will set in about one minute. Finally polish off the surface.

In the case of old valves, first melt out the old fusible metal, then tap out and proceed as before. Where screwed-in plugs have been used, we discard the old plug and insert the new element in the body.

Ton drum plugs are filled by first screwing the shell into a plug of metal, to close the end and to give surface for rapid chilling later.

As far as can be judged by an experience of twenty months, we appear to be on the right track, inasmuch as—

(a) All used valves so far tested yield sufficiently close to the proper point as to indicate that they will function according to the intended manner, in case of exposure to fire, and

(b) All leakage of chlorine around the edges of the element seems to be done away with. A study of our records fails to show a single instance of a "leaker" at the fusible plug, either in transportation or in the customer's hands, during 1926.

Titanium Offers New Possibilities As a Pigment

By A. W. Hixson and W. W. Plechner

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ALTHOUGH titanium is far from being the "rare element" many seem to think it to be (it far exceeds in abundance in the earth's crust the "common" metals copper, zinc, lead, tin and manganese), there are comparatively few uses for it. Although widely disseminated, the important commercial deposits are more or less localized in Virginia and Florida in the United States, Quebec Province in Canada, in Norway, the East coast of Africa and at Travancore, India. Its use to any extent was first introduced in the manufacture of ferro alloys by the work of Rossi.

More recent, and of rapidly increasing importance, is the use of titanium oxide pigments. This development is largely a result of the more exacting requirements of white pigments, induced by competition between the manufacturers of those generally used, i.e., white lead, zinc oxide and lithopone.

The first use of titanium compounds as a pigment was by Dr. J. Overton, about 1870. He used rutile powdered and mixed with a vehicle, the mixture giving a resistant paint suitable for ships' bottoms. The first use of chemically prepared titanium oxide as a pigment is described in a patent granted to Rossi and Schroeder in 1916.

Two companies in the United States are now engaged in the manufacture of titanium oxide pigments. The Titanium Pigment Company was organized in 1916, erected a plant at Niagara Falls in 1917 and a second plant at St. Louis in 1922. The second company, the Commercial Pigments Company, has since been organized and has begun operations in a plant at Baltimore, Md., in 1928.

Desirable properties in any white pigment are: whiteness; chemical inertness; hiding power; a degree of subdivision which is amenable to control; ability to form mixtures with a vehicle which do not require a large amount of the vehicle merely for the purpose of wetting the pigment; when dried in a thin film that film should be as permanent as possible; on disintegration of the paint film a surface suitable for repainting should be left. Titanium dioxide, alone or combined with inert fillers, possesses these properties to a marked degree.

Paints made with titanium pigments have shown no tendency to crack or peel, but have worn down evenly and uniformly, the surface finally becoming powdery ("chalking") and remaining in excellent condition for repainting. Since a pure titanium oxide paint is inclined to be too elastic the addition of zinc oxide as a hardener gives an even more durable paint. Owing to the fact that titanium oxide is a neutral pigment it has no action whatsoever on the vehicle, making a very slow-drying "tacky" paint. This condition is overcome by the addition of zinc oxide or driers. Since titanium oxide, like the similar oxide of silicon, is the most stable compound of the metal, the pigment is extremely resistant to attack by any of the destructive agencies to which it is likely to be exposed. That it will resist the attack of sulphuric acid, which is notoriously the chief destructive agent in the air of cities, that it is not liable to discoloration by hydrogen sulphide, and that it is fully oxidized and therefore is not attacked by sea air or salt water, make it an excellent pigment.

The physical properties of this material further enhance its value as a pigment. Its opacity is greater than that of any other known white pigment. Coffignier states that the great opacity of titanium whites as compared [*Chimie et industrie*, vol. 7, page 651 (1922)] to other pigments is due to its comparatively high index of refraction. Opacity (hiding power) of a paint is partially dependent upon the extent to which light falling on it is reflected by the particles of pigment, a function of the refractive index. Coffignier gives the refractive indices as in Table I.

Table I—Refractive Indicices of Common Pigments

Titanium white	*2.71
Zinc sulphide, crystalline	2.37
Zinc sulphide, amorphous	2.30
Titanox (composite titanium pigment)	*2.30
White lead	1.99
Zinc oxide	1.90
Titanium oxide, hydrated	1.80
Blanc fixe	1.64
Linseed oil	1.49

When a combined precipitate of titanium oxide and barium sulphate (Titanox) is calcined the opacity of the product is far greater than the mean of the two constituents.

The hiding power as compared with other pigments [I. D. Hagar, *Paint, Oil & Chem. Rev.*, vol. 84, No. 12, page 17 (1927)] is given in Table II.

Table II—Comparative Hiding Power of Pigments

	Hiding Power Wt. Basis
White lead	100
Zinc oxide	115
Lithopone	125
Titanox	200

Another advantageous physical property is its comparatively low specific gravity.

Table III—Specific Gravity of Pigments

Titanium-calcium pigment	3.13
Titanium oxide	3.94
Barium sulphate	4.40
Titanox	4.30
Lithopone	4.30
Zinc oxide	5.66
Basic lead sulphate	6.41
White lead	6.70

*In a private communication from Mr. L. W. Ryan of the Titanium Pigment Company, the index of refraction of Titanox is given as 1.89, and Titanium Oxide as 2.55, recent determinations not previously published.

H. D. Bruce in discussing the tinting strength of pigments [*Bureau Standards J. Research,* vol. 1, page 125 (1928)] gives the percentage brightness of the various white pigments relative to magnesium carbonate block and also the index of brightening strength.

Table IV—Tinting Strength of Pigments

	Percentage Brightness Relative to $MgCO_3$ Block	Index of Brightening Strength
TiO_2	76.9	0.854
ZnS	77.7	.833
Titanox	79.1	.787
Lithopone	78.3	.777
ZnO	76.2	.767
BC white lead	76.6	.736
Blanc fixe	60.8	.388

Examination of the table shows the titanium pigments to be comparatively high in relative brightness.

Further, the pigment is non-toxic as has been proved by feeding rabbits over long periods (Lehman, K. B. & Herget, L., *Chem. Ztg.,* vol. 51, page 793).

The oil requirement is somewhat high, 17-24 per cent oil to form a paste.

It can withstand high temperatures making it especially suitable for baking enamels.

Titanium pigments hitherto have consisted generally of about 25-30 per cent titanium oxide precipitated on 70-75 per cent of some inert filler, more usually calcium sulphate or barium sulphate. Titanox, 25 per cent titanium oxide —75 per cent barium sulphate, bulks 2.792 gal. per 100 lb. Titanium calcium pigment, 30 per cent titanium oxide—70 per cent calcium sulphate, bulks 3.84 gal. per 100 lb. Pure titanium oxide, which has only recently been placed on the market as a pigment, is a fine white product, bulks 3.05 gal. per 100 lb. and has a hiding power two and a half times that of Titanox. This high hiding power makes it especially suitable for use in lacquer enamels, as little as 10 per cent pigment giving satisfactory results. Use of so small amount of pigment improves the gloss, tends to give a continuous film, increases elasticity, and aids in ease of application.

Singmaster and Breyer state [Annual Survey of American Chemistry, vol. 3 (1928)]: "Lithopone titanium mixtures containing 15 per cent of TiO_2, either admixed with the lithopone or muffled with the lithopone in the process of manufacture, are appearing on the market and have properties which make them very desirable pigments, the TiO_2 imparting a certain amount of anti-yellowing characteristic to the lithopone and a degree of weathering resistance in exterior exposures, in both of which properties lithopone benefits by reinforcement with other pigments."

A comparison of the prices of the various white pigments may prove of interest. The following Table V, gives the prices per pound, car lots, barrels of the domestic pigments as reported in the New York Market of February, 1929.

Table V—Prices of Pigments

Barytes (ton)	$30.50
Blanc fixe	0.03½
Lithopone	0.05½
Zinc oxide, American process	
Commercial lead free	0.06½
5, 10, 20 and 35 per cent leaded	0.06½
White lead	
Basic carbonate	0.08½
Basic sulphate	0.08
Titanox	0.09½
Zinc oxide, French process	
Red seal	0.09½
Green seal	0.10½
White seal	0.11½
Titanium dioxide	0.30

On a pound for pound basis titanium white is the most expensive of the white pigments with the exception of French process zinc oxide, and of course, titanium dioxide. However, if the price per square foot of painted surface is used as the basis of comparison, titanium white no longer is the most expensive. Table VI [H. S. Hallett, *Proc. Am. Soc. Testing Materials,* vol. 26, part ii, page 538 (1926)] shows the square feet of surface hidden by one pound of pigment.

Table VI—Area Hidden By Pound of Pigment

White lead	20 sq.ft.lb.
Basic lead sulphate	15
Zinc oxide	23
Lithopone	25
Titanox	40

Combining Tables V and VI so as to obtain the price of pigment per 100 sq.ft. of painted surface, Table VII is obtained which indicates that only lithopone is less in actual cost.

Table VII—Price of Pigment per 100 Sq.Ft. of Painted Surface

Lithopone	$0.22 per 100 sq.ft.
Titanox	0.238 per 100 sq.ft.
Zinc oxide (American)	0.294 per 100 sq.ft.
White lead	0.425 per 100 sq.ft.
Basic lead sulphate	0.533 per 100 sq.ft.

In the preparation of the pigments, whether pure titanium oxide or composite, nearly all processes involve the hydrolysis of a titanium solution to precipitate a hydrated oxide which is dried and calcined. If the hydrolysis is carried on in the presence of insoluble fillers, e.g., precipitated barium sulphate or calcium sulphate, silica, clay, asbestine, etc., a mixed pigment is obtained wherein the titanium oxide is coalesced on the filler particles. In such a composite pigment the properties of the titanium oxide predominate. For the preparation of a white pigment the hydrolysis must be carried on in such a manner that iron compounds are not also hydrolyzed. This is generally accomplished by reducing the iron compounds to the ferrous state electrolytically or by the addition of metallic iron to the acid solution. The iron content is frequently lowered during the preliminary treatment of the ore, and also by crystallizing ferrous sulphate from the solution prior to hydrolysis.

For the preparation of titanium pigments several processes are described.

The old process of the Titanium Pigment Company may be briefly described as follows: 100 parts of ilemite is finely ground and mixed with 300 parts of sodium bisulphate (niter cake) and 50 parts of petroleum coke. This charge is melted in an electric furnace. It is assumed that the two principle reactions taking place are of the nature:

$$(1)\quad FeTiO_3 + Na_2SO_4 + 2C \rightarrow FeS + Na_2TiO_3 + 2CO_2$$

$$(2)\quad 2FeTiO_3 + 2Na_2SO_4 + 6C \rightarrow 2Na_2FeS + Ti_2O_3 + CO + 5CO_2$$

the first predominating. The melt is cast and slowly cooled. Due to differences in specific gravity the melt separates into two layers, provided solidification is sufficiently delayed, an upper layer containing the greater part of the iron, and a lower layer of sodium titanate relatively free of iron. The upper layer is brittle and is mechanically separated from the lower. The titanate layer is broken up, leached with water, and the final residue treated with dilute sulphuric acid at the boiling point. The titanium content is hydrolyzed and remains as hydroxide or basic sulphate. This is dried and treated with 2.5 to 2.6 parts of 95 per cent sulphuric acid at 100-150 deg. C. in cast-iron pots. The resulting mixture is diluted to three times its volume in lead-lined vats and filtered. A portion of this solution is electrolyzed, reducing the titanium from the tetravalent to the trivalent

state. The reduced solution is added to the main portion of the solution thereby reducing the iron content to the ferrous state.

A paste of precipitate barium sulphide is added, in such quantity that the final pigment will be 25 per cent titanium oxide and 75 per cent barium sulphate (marketed as Titanox). The mixture is maintained at the boiling point for several hours effecting hydrolysis of the titanium and thereby precipitating hydrated titanium oxide upon the barium sulphate particles. The mixed precipitate is filtered, thoroughly washed, dried and finally calcined in rotary furnaces.

The present process of the Titanium Pigment Company is that of the Titan A.S. of Norway. Ilmenite is treated with 66 deg. Bé. sulphuric acid in acid-proof brick-lined pans. The resultant product is a dry mass consisting of ferrous sulphate, titanium sulphate, silica, unattacked ilmenite and comparatively small quantities of free acid. The reaction mass is leached with cold water, the residue being washed and sent back to the reaction pans. Scrap iron is added to the solution to effect reduction of the iron to the ferrous state and the reduced solution is clarified. At this point barium sulphate paste is added as indicated above and hydrolysis carried on as in the old process. Before calcination of the product calcium phosphate is added to obtain a pigment of greater whiteness. Of course, for the preparation of pure titanium oxide the addition of barium sulphate or other fillers is omitted.

The Commercial Pigment Company follows essentially the same procedure to obtain a titanic sulphate-ferrous sulphate solution. This was described in *Chem. & Met.* in July, 1928.

The third general process, that described in the patents of Carteret and Devaux, consists of reducing titaniferous materials with coke at a red heat.

Improving Fractionation for Cracking Processes

By D. B. Keyes

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FRACTIONATION of the crude distillate from cracking stills is a much more developed art today that it was a few years ago. There is, however, still room for improvement, not only in column design, but also in the arrangement of columns and heat-transformer equipment. The object of this article is to show two satisfactory fractionating schemes which can be readily used in connection with such well-known cracking processes as the Holmes-Manley and the Dubbs.

The first scheme is illustrated in Fig. 1. The product of the cracking still is divided into two constituents, one, the vapor and the other, the liquid and solid. The vapor, as illustrated here, passes into the bottom of an ordinary fractionating column and indirectly heats the liquid that accumulates at that point, thus driving out any gasoline that would otherwise remain in the recycle stock. The vapor then passes on through a reduction valve and enters the side of the column. The reduction in pressure vaporizes any liquid that may have been formed and makes the operation more easily controlled. This reduction should be between 50 and 100 lb., since greater reduction would materially decrease the efficiency of the subsequent condensation. The reflux at the top of the column is produced by cold feed passing through a coil. A gasoline product leaves the top of the column, is condensed, and passes to a gas separator in accordance with usual practice.

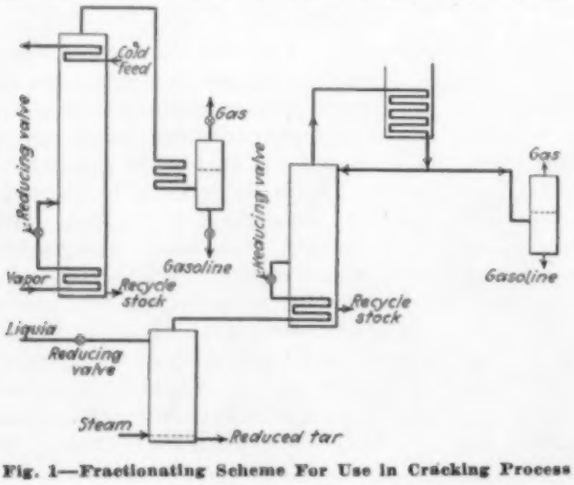


Fig. 1—Fractionating Scheme For Use in Cracking Process

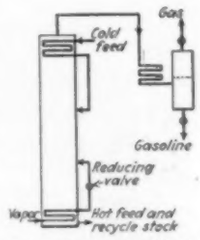


Fig. 2—A Modified Scheme

The crude tar which is usually flashed or left as such is passed in this case to the top of a stripping column. The pressure is somewhat reduced. Steam or gas passes in at the bottom and any gasoline or recycle stock is driven out at the top. A "reduced" tar comes out at the bottom. The vapor mixture from the top of the stripping column passes to a fractionating column similar in construction to the one previously described where the pressure is again reduced. Recycle stock comes from the bottom of this column and the gasoline from the top. The usual condenser (part of the condensate used as reflux) and gas separator are employed.

In Fig. 2 is shown a modification of the fractionating "hook-up" for the vapor. In this case it was desired to heat the feed by direct contact with the vapors. The vapors from the cracking still or reaction chambers pass through a coil at the bottom of the column and then through a reduction valve, the same as in Fig. 1. The vapors enter the side of the column, meeting the feed coming down. The cold feed has been somewhat heated by passing through a coil (used as a reflux condensor) at the top of the column. It obtains its final heating by direct contact with the vapors in the middle of the column. The lower third of this column is used to strip any valuable products from the hot feed before it passes out at the bottom. The top third of the column acts as a fractionating section; here recycle stock is separated from the gasoline and gas. The recycle stock goes downward with the feed and passes out at the bottom. The gasoline vapors from the top of the column are condensed and separated from the gas as indicated.

It should be noted that there is considerable more vapor to be fractionated than liquid, so the fractionating unit for the vapor will be duplicated for every cracking unit, whereas the fractionating unit for the crude tar will probably take care of several cracking units.

General view of the raw material storage and preparation equipment at the Austin Powder Company's plant at Glen Willow, Ohio, near Cleveland. Note the isolation of buildings

Highlights in Electrifying a Powder Mill

By Fred L. A. Schmidt
General Electric Company, Cleveland, Ohio

BLACK POWDER manufacture is classed among the hazardous industries. The temperamental qualities of the materials used, and the resultant explosive product have made manufacturers extremely cautious. As a result processes and equipment have changed slowly. It is only after thorough investigation and trial that changes are made.

The ingredients used in making powder are commercial sulphur (brimstone), nitrate of soda, and charcoal. All of these materials, when finely ground, are difficult to confine, as they are comparatively light and a slight breeze carries them a long distance. Hence, in view of the hygroscopic and corrosive character of sodium nitrate and the flammability of charcoal, special precautions are necessary.

The process of manufacture consists of but few steps. The raw materials are prepared in a pulverizer where the sulphur and charcoal are finely ground. The nitrate of soda is separately ground and passed under a magnetic separator to remove ferrous metals. These materials then are properly proportioned and ground in a wheelmill, a device quite similar to the dry-pan used in the clay industry.

The fineness to which the three ingredients are ground in this mill determines to a great extent the rapidity of burning or explosion. This product is then put in hydraulic presses and formed dry, under heavy pressure, into slabs. The slabs are granulated, the granules are graded as to size and are placed in a glaze mill—a kind of tumbling barrel—where they are polished, ready for shipping. During the entire process, the materials must be handled dry.

Recently a demand has developed for powder in pellet form. This is prepared by taking the granulated powder, and instead of glazing, putting it into a mechanical press

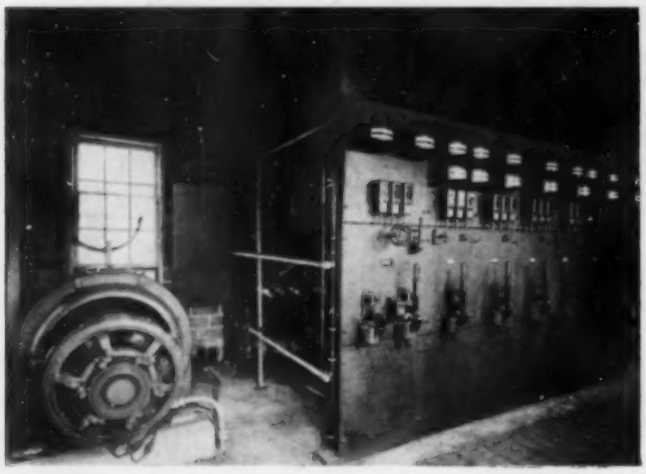
Fig. 2, Below, Shows One View of the Plant With a Row of Wheelmill Houses at the Left. Note the Heavy Construction. At the Right, Fig. 3 Proves That a Spare Gear for the Wheelmills Has Not Been Needed for 30 Years

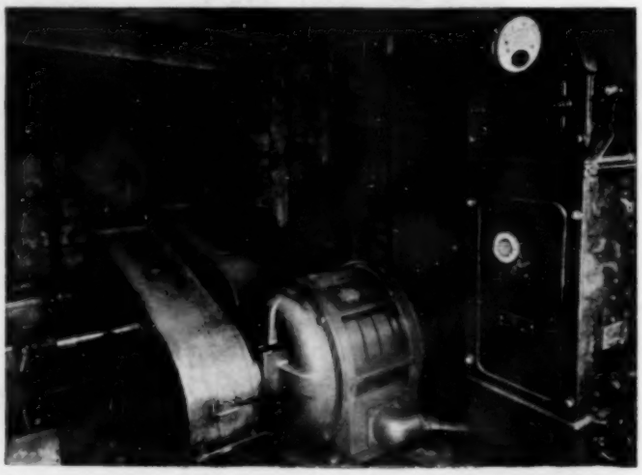
where the grains are formed into thick-walled cylinders, approximately 2 in. long by $1\frac{1}{8}$ in. to 2 in. diameter, with a hole through the center about $\frac{3}{4}$ in. diameter. These cylinders or pellets are thoroughly dried, assembled to form sticks about the size of dynamite sticks, wrapped in paper, waxed, and boxed for shipment.

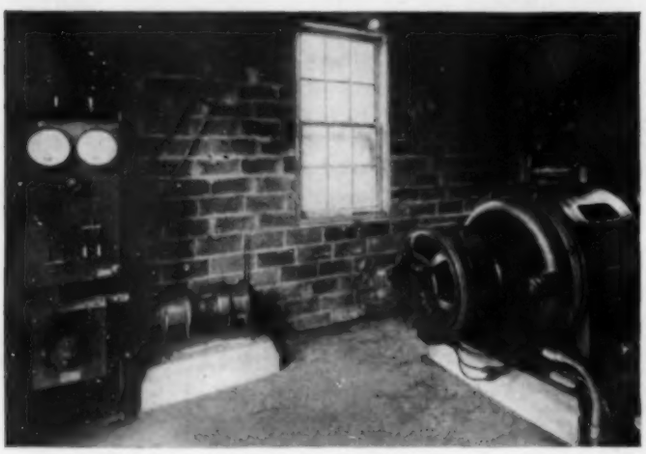
The housing units in which the production is carried on are ordinarily small and scattered over wide areas to prevent spread of fire and to limit damage from accident. The electrification of the Austin Powder Company's plant at Falls Junction, Ohio, therefore, presented many interesting problems. All wiring had to be kept outside of the buildings; explosive dust, which was also corrosive and a good conductor of electricity, had to be guarded against, and equipment had to be installed to withstand shocks of destructive nature.

The substation through which is delivered the purchased power was made with hollow tile walls and a light wooden roof. The switchboard, Fig. 4, usually supported on the side walls, was secured to a heavy steel rail framework set in a concrete foundation, this framework being of sufficient height to protect the buses should the building collapse. A 300-kva. synchronous condenser was installed to insure a constant voltage supply and to reduce power costs. This is shown in Fig. 5, which also shows, at the left, the small motor-generator set that was provided for direct current for the magnetic separator.

A 4,000-volt power distribution supplies power to load centers, where transformer banks reduce the voltage to 440 volts. These transformer banks are placed on concrete slabs cast on the ground, only the light switching equipment being mounted on the poles. The 440-volt power service is carried to the motors overhead, except to the wheelmills where the secondary distribution is carried through leaded park cable underground, all points where equipment is installed being adequately protected with lightning arresters.







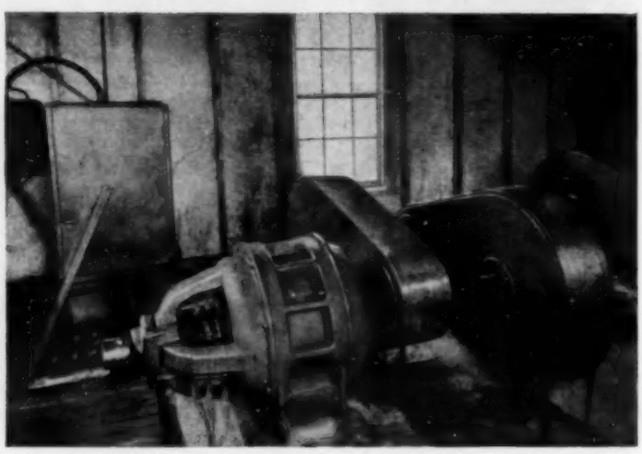


Fig. 4—4,000/440-Volt Power Distribution Substation in Which the Equipment is Installed with the Possibility of Roof Collapse in Mind

Fig. 5—300-Kva., 900-R.p.m., 4,000-Volt Synchronous Condenser for Power Factor Correction and Voltage Stabilization. The Small 1½ Kw. Motor Generator Set at the Left Steps Down 440-Volt A.c. to 125-Volt D.c. for the Magnetic Separator

Fig. 6—One of the 40-Hp., 900-R.p.m. Induction Motors Used to Drive the Wheelmills. There Are Four Other Similar Motors

Fig. 7—Pellet Presses Are Driven by 50-Hp., 900-R.p.m. Induction Motors Through Chain Drives Giving a Total Reduction of 865 to 12 R.p.m. Note the Automatic Stop Relay at the Left Which, Using a Small Synchronous Motor as a Timing Device, Controls the Press Cycle

Each motor installation is in a small building adjacent to the point where power is to be used. The motors as a rule are of the squirrel-cage induction type, insulated to withstand both dust and moisture conditions. Oil-immersed, silent-chain drives reduce the speed to the main drive shaft which transmits the power through the walls to the driven machinery. Starting equipment is dust-proof with oil-immersed, push-button stations.

The wheelmills are driven by squirrel-cage induction motors rated 40 hp., 40 deg. C., 900 r.p.m., with hand starting compensators, the load starting being handled by means of friction clutches to provide a very slow and steady acceleration and to permit sufficient lapse of time to absorb the heat generated in starting the wheels. One of these appears in Fig. 6.

It is interesting to note that the five wheel-mills were formerly driven by an outdoor line shaft approximately six inches in diameter and over 200 ft. long, supported every ten feet on grease-lubricated bearings. All of this equipment was scrapped, together with engines that supplied the power.

Fig. 8—Control Panel Used for Definite Time-Limit Stopping of the Pellet Presses

The most interesting motor application is the pellet press. This motor must start every four minutes, run three minutes, and stop automatically when the pellets are formed. A 50-hp. wound-rotor motor was used, the speed reduction being obtained by means of a silent-chain reduction and reduction gear giving a speed ratio of 865 to 12 r.p.m. Fig. 7 shows one of the two motors which has been installed for this service.

The automatic stopping of the motor is controlled by a magnetic switch (Fig. 8) to which was added a relay. The number of revolutions of the press required to complete the operation being calculated, the time of running is definitely fixed. The relay (driven by a synchronous motor) provides a very accurate timing device for stopping the motor. Although the starter operates 360 times each day, the contacts, after eight months of this service, show very little sign of wear.

The motion required to replace dies in this press is so slow that jogging the motor is too fast. The slow motion is obtained by connecting an automobile crank to the end of the motor shaft and turning the entire system by hand, a rather primitive but very satisfactory method.

Special care is used because of the wide range of temperatures experienced in the unheated motor rooms and the danger incident to excessive temperature. Special grades of oil are used in the compensators and bearings. It is evident that the owners have spared no expense to make the equipment absolutely safe and they are insuring this safety by constant inspection and maintenance of equipment, supported by adequate renewal parts.

Brief History of the Spray Cooling of Water

By B. R. T. Collins

Sprayco Incorporated, Boston

CHEMICAL engineering industries demand cool circulating water for such apparatus as condensers, evaporators, jackets of special equipment and ammonia condensers. In order to avoid high cost for circulating water, it has been the practice to cool it and use it over and over again.

Sixty years ago in England the first cooling ponds were constructed to avoid the use of river water which contained waste products from chemical and other manufacturing processes, thereby rendering it unfit for cooling purposes. These cooling ponds were constructed with a series of partitions arranged so as to cause the incoming hot water to travel over the entire area of the pond before reaching the pump from which the supply for the condensers or jackets was drawn. Some ponds of this character are still in use in England and in this country, but naturally they are very inefficient, because only the surface is exposed for evaporation and cooling by contract with the air, whereas most of the water is below the surface and the heat is liberated very slowly.

Next after the cooling ponds with partitions came various systems of wooden troughs, constructed so as to deliver the hot water at a considerable distance from the intake well. This avoided the use of partitions, but was little, if any, more efficient. In order to increase the cooling effect, other devices were added to these cooling ponds, such as a rack at one end of the pond filled with brush, on top of which the hot water was discharged so that a certain amount of cooling was obtained as the water trickled down into the pond over the brush.

Later, so-called natural-draft cooling towers were developed, consisting of a structure filled with grille work for breaking up the water into drops during its passage from a system of distributing troughs on top to a basin below, a current of air being induced through the structure by means of a chimney. Also, so-called atmospheric cooling towers have been used, consisting of an open structure with a series of platforms or grilles over which the water trickles, breaking up more or less on its descent trom the top of the tower.

ABOUT 25 years ago spray nozzles were first used in this country for cooling water, the first nozzles requiring about 18 lb. pressure in order to break the water up sufficiently to obtain satisfactory cooling results. This high pressure carried the spray into the air to such an extent that it blew over a considerable area during heavy winds, and hence did not prove satisfactory, on account of the annoyance caused by the drift, which sometimes carried 300 to 400 ft. away from the cooling pond.

About 18 years ago the first low-pressure spray nozzle was developed. This nozzle operated at 7 lb. pressure at the nozzle, and confined the spray to a reasonable area, even in windy weather, so that the difficulty from drift with the high-pressure nozzles was avoided. During the past 15 years there have been between 6,000 and 8,000 installations of cooling ponds made in the United States and other countries. Some of the types of nozzle used have had small passages, which might become clogged with foreign matter if there should be any in the circulating water. Consequently, there is a tendency now toward nozzles which have no center nor openings smaller than the orifice, and which rely upon impact of the water against itself to obtain the spraying effect.

A recent development of this type is the "ramp bottom" nozzle, which, as the name implies, has a bottom constructed on the principle of a spiral ramp, gradually ascending from the entrance until it has made one revolution. Here the water is caused to collide half way up on the entering stream, and this collision effect, with the large mixing chamber above, produces an absolutely uniform distribution of fine drops, leaving the orifice around its entire circumference.

Constituents of Value Added By Manufacturer

By S. B. Ladd

Washington, D. C.

INTERESTING facts concerning the value of products in the chemical industry can be obtained from a study of data from the Bureau of Census with respect to industries showing a large balance for value of products over and above material expense and labor (salaries, wages, and contract work). The tables show the per cent constituents of the value created by manufacture (which is the difference between cost of materials and value of products) requested by salaries, wages, contract work, and the remainder or balance, with the industries ranked according to the share of value of products represented by the said balance. As can be expected, the ranking industries with respect to the "balance" are those involving heavy overhead expenses for advertising and exploitation of products, the leading ten are the following:

		Added Ba'ance for Value of Products Per Cent
1.	Baking powders, yeast, and other leavening compounds	59.6
2.	Cash registers and calculating machines	56.5
3.	Chewing gum	55.2
4.	Patent medicines and compounds	51.5
5.	Rayon	50.1
6.	Ice, manufactured	49.5
7.	Perfumery, cosmetics, and toilet preparations	49.3
8.	Tobacco, chewing and smoking, and snuff	48.7
9.	Tobacco, cigars and cigarettes	48.6
10.	Bone black, carbon black, and lamp black	46.1

The basis for the percentages may be illustrated by the following example:

	Patent Medicines and Compounds		
		—Per Cent—	
Value of products	$247,564,046	....	100
Cost of materials	84,789,647	....	....
Value added by manufacture	162,774,399	100	65.8
Salaries	19,387,439	11.9	....
Wages	15,592,017	9.6	....
Contract work	176,946	0.1	....
Balance	127,617,997	78.4	51.5

Table I—Per cent distribution of value added by manufacture for all industries, 1925, 1919 and 1909

	Per Cent Distribution					
	Value Added by Mnfr: 100				Value of Products: 100	
	Salaries (1)	Wages (2)	Contract Work (3)	Balance (4)	Value Added By Mnfr.	Value Added Balance
1925	11.8	40.1	2.2	45.9	42.7	19.6
1919	11.6	42.2	1.9	44.3	40.1	19.8
1909	11.0	40.2	2.1	46.7	41.3	19.3

Table II—Per Cent Distribution of Value Added by Manufacture and Value Added by Manufacture Balance for Chemical and Allied Products, 1925.

	Per Cent Distribution					
	Value Added By Mnfr.: 100				Value of Products: 100	
Value of products	Salaries (1)	Wages (2)	Contract Work (3)	Balance (4)	Value Added By Mnfr.	Value Added Balance
$1,000,000,000 and over						
$500,000,000 to $1,000,000,000						
$100,000,000 to $500,000,000						
$50,000,000 to $100,000,000						
$25,000,000 to $50,000,000						
$10,000,000 to $25,000,000						
Less than $10,000,000.						
Chemicals and allied products	10.5	22.5	0.2	66.8	35.0	23.4
Classified Industries						
Baking powders, yeast and other leavening compounds	5.3	8.0	....	86.7	68.7	59.6
Patent medicines and compounds	11.9	9.6	0.1	78.4	65.8	51.5
Rayon	3.6	33.0	....	63.4	79.0	50.1
Perfumery, cosmetics and toilet preparations	12.3	10.3	0.2	77.2	63.8	49.3
Bone black, carbon black, and lamp black	5.8	19.3	0.4	74.5	61.9	46.1
Blacking, stains and dressings	11.9	14.1	....	74.0	61.1	45.2
Cleaning and polishing preparations	17.5	12.5	0.1	69.9	62.7	43.8
Druggists' preparations	13.4	18.7	0.1	67.8	62.2	43.6
Ink, writing	20.0	16.3	0.1	63.6	60.2	38.3
Gas, manufactured, illuminating and heating	14.2	24.3	....	61.5	60.8	37.4
Sulphuric, nitric and mixed acids	5.8	25.3	....	68.9	52.5	36.2
Bluing	16.5	16.1	0.8	66.6	53.1	35.4
Liquors, vinous	14.8	15.7	0.5	69.0	48.7	33.6
Ink, printing	18.6	18.1	0.5	62.8	53.2	33.4
Salt	11.7	35.6	0.3	52.4	59.6	31.2
Explosives	7.3	24.3	0.1	68.3	45.6	31.1
Lubricating greases not made in petroleum refineries	23.0	12.7	1.1	63.2	48.7	30.8
Chemicals, not elsewhere classified	10.9	29.2	0.1	59.8	50.3	30.1
Fireworks	10.0	39.3	0.6	50.1	60.2	30.1
Alcohol, ethyl	4.5	9.6	0.2	85.7	33.2	28.4
Mucilage, paste and other adhesives, not elsewhere classified	15.8	17.8	0.1	66.3	42.8	28.4
Drug grinding	15.9	20.1	0.4	63.6	41.7	26.5
Paints and varnishes	17.1	20.0	0.2	62.7	37.6	23.6
Soap	11.0	19.8	0.1	69.1	33.6	23.2
Candles	22.9	28.9	0.2	48.0	45.5	21.9
Ammunition and related products	11.7	42.3	....	46.0	45.3	20.8
Fertilizers	11.9	25.7	0.1	62.3	33.4	20.8
Oils, not elsewhere classified	11.3	15.2	0.1	73.4	27.7	20.3
Tanning materials, natural dyestuffs, mordants and assistants, and sizes	17.9	24.9	0.1	57.1	34.6	19.8
Glue and gelatin	14.3	38.1	0.1	47.5	40.5	19.2
Oils, essential	9.4	18.5	....	72.1	25.8	18.6
Grease and tallow, not including lubricating greases	13.0	42.4	0.1	44.5	34.5	15.4
Wood distillation and charcoal manufacture	12.8	45.5	0.6	41.1	37.1	15.3
Coke, not including gashouse coke	6.8	36.5	....	56.7	26.6	15.1
Petroleum refining	5.7	21.5	0.5	72.3	20.5	14.8
Oil, cake and meal, cottonseed	12.1	22.2	1.0	64.7	17.4	11.3
Oil, cake and meal, linseed	4.5	22.9	0.1	72.5	13.4	9.7

What Constitutes Invention?

By Louis Burgess

Patent Attorney, New York

EDITOR'S NOTE: *Too many engineers consider patent protection a complicated problem to be left entirely in the hands of the legal specialist. Too many patent attorneys lack the engineering viewpoint and are consequently handicapped in technical work. The author of the present article combines practical experience in both the legal and technical phases of his subject. Educated as an attorney and engaged in general practice, his scientific inclinations led him into the field of invention. The Standard Oil Company of New Jersey became interested in certain of his inventions and for a number of years Mr. Burgess was employed in the development department of this company in engineering work on these and other inventions. Then he joined the patent department of the company and subsequently resigned to enter the practice of patent law in New York City. In a later issue Mr. Burgess will consider the procedure in the patent office and the litigation through which patent protection must sometimes be secured.*

WHAT constitutes invention is a question presented to engineers more persistently than to the members of any other class. Inability to determine the question may prove expensive. Many an engineer has been painfully surprised on finding that someone else has patented and monopolized an idea for which he was responsible and that he cannot even use it, much less derive the profit from extending its use to others.

There is a strong tendency for the engineer to regard every product of his brain as "just engineering." Moreover, by reason of his scientific training and continuous application to the pursuit of truth the engineer is apt to be so underdeveloped in business astuteness as to fail to protect his ideas to the fullest possible extent. The individual who combines good engineering with the ability to protect himself financially is the rare exception. This philosophical presentation of the subject of invention may prove helpful in establishing a more correct perspective and in indicating the basic considerations which determine when a patent should be applied for.

Invention in the true sense comprehends those products of intellectual application which are not expressed or implicit in accumulated human knowledge, viz., those developments in any branch of knowledge which are neither specifically disclosed nor suggested to intelligent persons familiar with what is already known. The accumulated knowledge may be in any form or source, provided it is actually available to society. The usual repositories of such knowledge are text books, periodicals, issued patents, articles, machines and the practices of artisans and craftsmen. Private memoranda, trade pamphlets, and the like, are not available to society in general and do not constitute a part of this knowledge, although they become such when placed in the files of a public library. Those results which are expressly set forth or inferable from what is known are not invention; those things which are not so deducible are. The test is, What does this accumulated knowledge teach to the mechanic, manufacturer, or engineer skilled in the particular field? That which would be inferred from the previous machine, practice or publication is not invention and cannot be patented; everything else is.

While the basic principle is uniform and unchanging, the standard by which a contribution is measured grows from moment to moment with the progressive growth of knowledge and in some cases undergoes a reverse change, as certain arts and crafts become lost and therefore subject to rediscovery.

INVENTION does not necessarily comprehend things which in dignity or importance transcend the results of conventional engineering; its subject matter ranges from things which are foolishly simple to those which are difficult for any but the specialist to follow with understanding. This cannot be overemphasized; there is an all too universal tendency to fail to protect ideas which are new and patentable where the ideas are not deep or abstruse.

Every invention, when communicated to the world, becomes an added bit of accumulated knowledge—in fact, invention is the border region between the known and that which is still undevised or undiscovered. For this reason the field of invention shifts from day to day; thus, steam engines, railroads, wired telegraphy, electric illumination, radio telegraphy, turbines, radio broadcasting, airplanes and television have had different although overlapping, periods of maximum inventive activity. No field ever becomes so completely developed that it is no longer subject matter for invention, and any field may be forced back into a period of inventive activity by a radical discovery which opens the way for new improvements.

PROCESSES by which inventions are produced are interesting; at times they result from sheer ignorance, as, for example, in those not infrequent cases where someone knows too little of conventional engineering to realize that a certain thing is impractical and proceeds to its accomplishment. Inventions are frequently suggested by environmental peculiarities which force diverse things into mental association, with the result that some new inference is drawn; thus, a man who is translated from one field of industry to a radically different field may perceive possibilities and relationships which had never occurred to those accustomed to the surroundings and activities of that field. A large proportion of inventions are the result of work in new industrial fields, such as branches of industry which were not previously developed and which undergo rapid growth because the evolution of popular taste has suddenly created a demand, or the development of related industries has swept away obstacles which impeded development. Some

fields of industry have undergone a steady development extending over a period of possibly hundreds of years, while others belonging to the class just mentioned grow suddenly when favorable conditions are created. The development of automobile accessories followed in this way as a necessary consequence upon the growing use of the automobile. The development of elevators was conditioned upon the increased growth of cities and the rise in property values which made the multi-story building a profitable investment.

These branches of industry which suddenly spring into being are probably the easiest field for inventive work. Almost anything passes for invention where there is little or no prior art with which to compare it, and such contributions are *bona fide* inventions as measured by the standard here set forth, although the ability involved is sometimes quite average and the same ideas would doubtless have been evolved in a short time through other channels. These considerations should be carried in mind by the engineer working in a new field. There is a tendency to regard every advance as "engineering" and to omit patent protection, with the consequence that valuable opportunities are lost and the engineer is placed on the defensive by those who are more aggressive.

MENTAL processes of an inventor are unimportant except as they may incidentally reflect on this question. One man may labor for years on a problem and produce nothing original while another may achieve the solution without application or effort. It is of the very nature of invention that we do not know how to produce it and cannot, therefore, scrutinize its genesis too sharply.

The question whether invention existed in any particular case can only be determined *ex post facto* by recreating as nearly as possible the situation which confronted the inventor at the time. Almost any solution, once it is accomplished, looks like a reasonable deduction from prior knowledge and for this reason the law relies strongly on other proofs than a comparative examination of a patent with the prior art. The prolonged existence of an unsatisfied want, prior unsuccessful efforts to solve a problem or immediate commercial acceptance of the result are accepted as indications of the inventive character of the ultimate solution.

It should be appreciated that inventions are intrinsic to human development and exist without relationship to statutory law or judicial decision. The savage who first ascertained that fire could be created by rubbing two sticks together was an inventor in the same sense as the scientist who first perceived the control exercised by a static charge on the flow of electrons from a heated source and constructed an electric valve. Neither perception was in any way a function of law. Both of these would doubtless be considered pioneer inventions and it is interesting to note that both must have been followed by a number of lesser inventions which were improvements on the fundamental idea.

AFTER the first savage had shown that fire could be produced by rubbing two sticks together, a second doubtless discovered, probably after the lapse of a considerable time, that a better result was obtained with certain woods, for example, that the wood of dead trees responded more quickly than green timber. A later savage probably discovered that it was an advantage to have some dry moss handy to ignite from the dull glow produced by the friction. Some later ingenious savage must have discovered that by holding one end of a stick in the hollow of a shell, pressing the other end against a stationary piece, and rotating the stick rapidly with a bow string the desired result was speedily obtained. Incidentally this shell was probably the first use of anything which could be considered a bearing. This entire field of invention was swept into the discard, except for primitive people, by the discovery of flint and tinder and this in turn by the development of the match industry. Discretion enjoins comment on the automatic lighter.

An invention, moreover, does not consist of a mere idea. It must be applicable to the physical improvement of human environment; it must have utility. The purpose of inventions may be generically summarized as "to make things better or cheaper." For this reason an invention must consist of either a new creation or a method of creating. It is furthermore not sufficient merely to visualize the new creation or method; a mental concept alone will not accomplish the purpose. The invention must be demonstrated and lifted out of the domain of speculative possibility. No idea, however reasonable it may appear in the abstract, is more than a potentiality until it has been tested and found operative. The new article must be demonstrated by construction, the new method by application must be shown to possess practical utility. This step is dignified in patent parlance by the expression "Reduction to Practice" and is an essential attribute of invention. There is one exception to this: The law accepts the filing of an application for patent, if prosecuted to final allowance, as tantamount to a physical reduction.

The invention must be communicated to society and in terms sufficiently clear to be reproducible. Society must be placed in a position such that the article can be controllably recreated or the method intelligently repeated. An accidental production is not invention.

These requirements are, however, exclusive. The inventor may not realize the full value of his idea and may be utterly ignorant of the fundamental principles which make it operative. He is nevertheless truly an inventor and entitled to patent protection.

Expanding Uses for Tri-Sodium Phosphate

ACCORDING to the United States Tariff Commission the use of tri-sodium phosphate is rapidly increasing. It is valuable as a water-softener and as an emulsifier of grease. Its widest use is for general household and industrial cleaning, especially where non-abrasive material is desired. For household consumption a larger percentage of the total production is put up in small packages under various trade names. Some of these brands consist of tri-sodium phosphate only; some contain borax, soda ash, and other ingredients. For industrial cleaning, large quantities of tri-sodium phosphate are sold by the barrel to hardware manufacturers, automobile makers, garages, bottling works, restaurants, hotels, packing companies, dairies, and railroad companies.

In laundries, it is used to soften hard water and to remove stains left on goods during previous washings. In the paper industry, considerable quantities of it are used for cleaning felts and as a casein solvent. Minor uses are (1) as an ingredient of boiler compounds to remove boiler scale or to prevent its formation; (2) in the manufacture of tri-calcium phosphate used in tooth pastes, and in free-running salt as a stabilizer; and (3) in the preparation of paint removers.

Surface Films Protect Metals Against Corrosion

By F. N. Speller

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THAT the corrosion problem is not a product of the age of steel is clear by reference to the engineering literature of the early part of the past century. The deterioration of cast-iron water mains was causing concern in France in 1830 and extensive investigations were made leading up to a very thorough piece of research work by Robert Mallet extending from 1838 to 1843 (*J. N. E. Water Works Assn.*, Vol. 42, No. 3, pp. 261-265). Incidentally, cement lining of water mains which has been rather widely advocated in recent years was first suggested and used in 1836 for the protection of cast-iron pipe. Of course this problem has become of increasing importance with the increased use of corrodible metals and there is no doubt that the preventable waste amounts to several hundred millions of dollars per annum. For instance, carefully compiled data indicate a loss of one hundred twenty million a year in the American Petroleum industry (*Am. Pet. Inst. Bull.*, p. 245, Vol. IX, No. 7, Jan. 31, 1928). A considerable part of this and similar waste can undoubtedly be changed from a liability to a national asset.

Although this problem has long been known to be serious, only recently have the fundamental controlling factors received close scientific study. The present paper deals with one of the most important phenomena of corrosion of metals, viz., natural surface films and layers of various thicknesses which form on clean metals by reaction with external reagents.

The electrochemical theory of corrosion is now generally accepted in explanation of the initial corrosive attack at normal temperature. At higher temperatures and occasionally at temperatures not far above normal, direct chemical attack may occur. The initial reactions when metal is first exposed in contact with water and oxygen are:

I. M (metal) $+ 2H^+$ (ionic) $= M^{++}$ (ionic) $+ 2H$ (atomic)

II. (a) $2H$ (atomic) $+ \frac{1}{2}O_2 = H_2O$

(b) $2H$ (atomic) $= H_2$ (molecular)

The result of these reactions is that the solution tends to become alkaline at cathodic areas and acid at the anodes. Most metals when first exposed to water show initially a high rate of solution which quickly slows down as the polarizing film of hydrogen forms on cathodic areas, and the reaction can only continue by removal of the atomic hydrogen film either by combination with free oxygen or as hydrogen gas.

In case the corrosion products are insoluble, surface films form which greatly retard and sometimes stop the reaction. The metal surface may thus become completely covered with a film of corrosion products ranging in thickness from an atomic layer to one of measurable dimensions. These films may form on anodic or cathodic areas. After a film forms over an anodic area the potential may be reversed and this change of potential may occur repeatedly, resulting in fairly uniform corrosion.

ORDINARY corrosion is dependent upon maintenace of a supply of free oxygen and water at the metal surface and is largely influenced by temperature, rate of motion, hydrogen-ion concentration, local changes in potential due to oxygen concentration cells or dissimilar metals in contact, protective films and many other variables. The retardation of corrosion is most generally brought about, however, by the formation of more or less impermeable protective films on anodic areas. These films start to form shortly after the metal comes into contact with a corroding reagent. They consist essentially of the products of corrosion and attain their maximum protective power after a certain period of time. This may be looked upon as a self-healing property possessed by some metals without which they would have a considerably higher rate of deterioration and be much less useful. It should be our aim to cultivate this valuable property in metals. In fact it seems to the writer that metals having high corrosion resistance may be better developed by a scientific study of the stability and formation of surface films than by the old cut-and-try method of making and testing the effect of various alloying elements. Some work has already been done on the study of the electrical resistance of these films but more knowledge of the initial rate of attack and the rate at which corrosion is retarded by the alloying of certain elements with iron should be helpful in explaining the mechanism of the resistance to corrosion.

A protective surface film may be formed on clean metal, like iron or aluminum, when exposed to certain external film-building reagents such as chronic acid or oxygen, or the film may be formed essentially by the presence in the metal of a sufficient amount of other elements such as chromium or silicon, the oxides of which form with the oxides of iron a corrosion-resisting layer. The compound-oxides are often more resistant than single oxides, at least this is true in the case of oxides of iron with chromium, nickel and silicon.

Taking up the first group of protective films or layers we have:

High temperature oxidation. The work of Pilling and Bedworth (*J. Inst. Metals*, 29, 529-582, Disc. 583-594, (1923)) is well known. They found that certain metals increased in weight at a decreasing rate when exposed to

Extracts from a paper presented at the meeting of the American Association for the Advancement of Science, New York City, Dec. 27, 1928 to Jan. 2, 1929.

air at elevated temperatures and that below a certain critical temperature an equilibrium was established so that no further oxidation occurred. On some steels these oxide films are more or less permanent up to 900 deg. C., but at 1,000 deg. C. the oxide layer begins to break down. The resistance of metals at high temperatures is therefore due to the property they possess of forming a more or less durable film that is impervious to oxygen below a certain temperature. Any break in the oxide layer results in further attack and if the temperature is below the critical point a healing oxide again forms. This being true we would expect to find a low endurance limit under repeated stresses at temperatures that rapidly cause a surface film to form by oxidation. The resistance of metals to elevated temperatures is evidently due to the character of the oxide film produced.

Evans (Institute of Metals, Sept., 1928), reports an investigation which he made on some old galvanized iron roofing sheets which had resisted weather conditions successfully for fifteen years exposed to sea spray in the Scilly Islands. He showed definitely that the older material was more resistant than new galvanized sheets and that this was due not to any essential superiority in the older zinc coating but to a permanent protective film that had evidently been acquired during the initial period of exposure.

Action of acid inhibitors. Certain inhibitors reduce the rate of solution of metals in acid solutions. It has been shown that this is due to an increase in the hydrogen overpotential which is generally assumed to be due to formation of a film of discharged inhibitor substances absorbed on the cathodic areas. The theory of inhibitor action has been well stated by Chappell, Roetheli and McCarthy (*Ind. Eng. Chem.*, Vol. 20, p. 596, June, 1928) as follows:

> When immersed in acid, iron goes into solution at the anode areas, forming ions and discharging hydrogen ions at the cathode areas. These cathode areas may be said to occur principally in the narrow spaces of the grain boundaries in steel or between the metal and slag in wrought iron. Most inhibitors are either bases, such as quinoline, or positively charged colloids, and when these are present they travel to the cathode areas with the hydrogen. When the positively charged heavy particles are discharged, they cannot escape by gaseous evolution, and accordingly are adsorbed on the surface building up a protective layer.

Other examples of film protection. Another well-known example of film protection is found in the action of alkalies in solution. Some work done by the writer and C. R. Texter (*Ind. Eng. Chem.*, Vol. 16, No. 4, pp. 393-397, April, 1924) a few years ago indicated that the initial rate of corrosion of iron in water having various concentrations of caustic soda did not vary materially but that several minutes later the corrosion rate had decreased to a fixed minimum depending upon the hydroxyl concentration. This is explained by the lower solubility of ferrous hydroxide in the more alkaline solutions and the greater tendency to form a substantial protective layer of the products of corrosion under such conditions.

The relationship between the equilibrium values for alkalinity expressed as calcium carbonate, and the pH value in distilled water and in Baltimore tap water has been plotted from experimental data obtained by Baylis (*Am. Water Works Assn.*, Vol. 15, No. 6, pp. 598-633, June, 1926). For any definite alkalinity a calcium carbonate scale tends to form when the pH value is raised above the equilibrium value for any particular water. This method of controlling corrosion and preventing "red water" has been successfully put into practice in the city of Baltimore.

Passivity is induced in iron and ferrous alloys, zinc, aluminum, copper and other metals when they are subject to the action of strong oxidizing reagents such as strong nitric acid, chromic acid or in a rather strong solution of chromates.[1] A metal may also be rendered passive to corroding reagents by anodic attack. To form such a film, the voltage must be sufficiently high to cause evolution of oxygen at the anode.

SO LONG as a certain low concentration of the passivefying reagent is in contact with metal, it is kept immune from attack under the action of corrosive solutions even with alternating stresses that in the absence of the inhibitor would cause rapid destruction of the metal.

All these observations and experiments, by inference, point to passivity as being due to invisible film protection. Evans (*J. Chem. Soc.*, pp. 1020-1040, 1927) showed that some of these invisible passive films may be raised off the metal surface and rendered visible.

It is not surprising that these very resistant films are so thin as to be invisible, as corrosion under these conditions is quickly arrested and the growth of the film must then cease. Evans (ibid) has shown that oxygen uniformly distributed over the surface of a metal in water tends to passivify iron. This may explain the abnormal resistance occasionally found in old iron or steel and zinc-coated iron and steel. On the other hand we have found that variations in oxygen concentration have a marked tendency to break down passive films. There is, therefore, good ground for considering passivity of all kinds, including the slow corrosion of special steels resistant to corrosion, as due to film protection.

The accelerating influence of contact between dissimilar metals may be offset more or less by the use of passivifying reagents, probably due to the formation of insulating films.

To passivify metals, in practice, it is most economical to use sodium dichromate with sufficient caustic soda to form the normal chromate. We have applied this treatment to stop corrosion in water cooling systems where the water is recirculated.

Metals resistant to corrosion. Having considered a few examples of unstable metals which may be made less corrodible by the formation of a protective layer on the metal surface, let us now consider what can be done toward prolonging the life of such a metal still further by alloying it with other metals for the purpose of making a more resistant surface layer.

When the electrolytic theory was first discussed some were misled to the conclusion that a high degree of purity and a more homogeneous structure would give much longer life to ordinary steel. Greater purity of the metal has not proved to be the answer except under extraordinary conditions. We now know that external factors usually control the rate of corrosion and that all commercial grades of iron are much alike in being naturally more corrodible under some conditions than metals like chromium, nickel, or copper, for example.

[1] E. L. Chappell of our Research Dept. has shown that hot dipped zinc coated pipe when quenched in water carrying a small amount of chromate is much more resistant to corrosion than when the chromate is not added, and is also much more resistant than when the pipe after cooling is immersed in the same chromate solution.

Fortunately, iron can alloy with a large proportion of these more resistant metals, forming solid solutions that are much more resistant in many cases than the alloying metals themselves. The essential characteristics of a rust-resisting metal are apparently that it should have a low solution pressure and form impermeable, tenacious, and stable surface films in combination with corroding reagents. These films should be and usually are much more stable than the metals which enter into their structure, but as they are attacked differently under different conditions it is not to be expected that a metal will soon be found that is equally resistant under all conditions. Gold and platinum are at present the only metals that are resistant to nearly all corroding reagents.

TAKE THE CASE of steel with the addition of one-quarter of 1 per cent of copper, which is now established commercially. Long-time exposure tests in service have shown an increased life of from two to four times in atmosphere by the addition of this amount of copper to ordinary Bessemer steel, whereas the same steel under water or in corrosive soil is usually no better than ordinary steel without copper. In the former case when the metal first goes into solution copper is precipitated and a double oxide of copper and iron formed. In water, on the other hand, the rust is loosely formed and not so dense, suggesting that the small amount of copper is carried away from the corroding surface when the metal dissolves and hence cannot play a part in the formation of a protective layer. It is a curious fact that copper forms a denser and more stable layer on the more impure forms of steel, so that copper-bearing Bessemer steel is more resistant in certain atmospheres than open hearth steel or commercially pure iron with the same copper contents.

FOR MOST purposes where large tonnages are involved the world is interested in the use of iron as a base for a more durable metal having useful physical properties. Small additions (1 or 2 per cent) of chromium, nickel, or silicon to iron have not given encouraging results, under ordinary corrosion, but when either the chromium or silicon exceeds 12 or 14 per cent a very marked stability is produced, particularly under atmospheric exposure or where the metal is exposed to strong oxidizing conditions. This amount of chromium in solid solution in iron forms a very resistant oxide film which is self healing except under those conditions (as in the presence of an excess of chlorides) where the film is destroyed. High chromium iron when immersed in copper chloride solution after careful cleaning in the absence of oxygen goes into solution and precipitates copper like ordinary iron. The addition of 8 per cent or more of nickel still further increases the stability of the surface film under a wider range of conditions. An attractive field of research is open in the study of the stability of films made up of combinations of oxides. More fundamental information is also required on the initial rate of corrosion of these alloys, which appears to depend upon the type of anodic film protective produced in the corroding media.

PARTICLES OF SCALE on the surface of chrome-iron induce a difference of potential which results in pitting, so that to get the best results the metal should be polished. High chromium steel is also subject to pitting in corrosive soils. This and other circumstantial evidence, as pointed out before in this paper, leads to the conclusion that the superior resistance of such steels is due to the surface film formed rather than to any great reduction in the solution pressure of the metal by the chromium addition. It is also significant to note in connection with the question why certain steels are much more durable than others in certain media, that high chrome-iron or steel is 10 to 20 times more durable than ordinary steel when immersed in fresh water saturated with air, but when subject to a large number of cycles of stress in contact with water they show less than twice the durability of ordinary carbon steel. Some recent experiments in our laboratory indicate that when a band of rubber is placed around a high chrome-iron test piece while under stress so as to cause a local difference in oxygen concentration, the endurance limit is still further reduced by the oxygen concentration cell produced. As the life of this steel is so materially influenced by small variations in surface potential, the surface film hypothesis seems highly probable.

THIS BEING true it follows that to improve the durability of iron the procedure would naturally be first to investigate the compounds of iron and other metals that are most resistant under certain conditions of service, then select the most likely ones and endeavor to form solid solutions of iron and other metals that will form strong resistant films when the metal corrodes. The alloying metals available in practice include principally copper, nickel, chromium, silicon, and aluminum. As mixtures of these compounds of metals are as a rule more stable, a research of this kind is likely to take some time and patience. However, much has already been learned by experience and useful alloys of iron, chromium and nickel are now available for various purposes where first cost is of secondary importance. A low-priced alloy is needed which will be two or three times as durable as ordinary iron in air, soil or natural waters without much additional cost. Experience with the iron-chromium, iron-nickel, and iron-silicon series points to the necessity of a large amount (over 13 per cent) of these alloying metals in solid solution and does not offer much promise of the early development of a low-cost rust-resisting iron alloy.

Aluminum may be mentioned as an example of a metal that quickly forms a stable oxide film and on this account possesses high resistance to atmospheric corrosion. In contact with chloride solutions this film is soon penetrated and destroyed and in consequence under these conditions the metal has a comparatively short life. Aluminum in considerable amounts (perhaps with other metals) may prove to be a useful alloying agent in iron for resisting certain kinds of exposure.

VARIATIONS in water, local differences in surface potential and other factors affect the stability of the film formed on metals so that tests should be made under service conditions or by using the same controlling factors that are found in practice. Too often the impatient investigator resorts to the acid test and misleading statements are prematurely published which tend to discredit other work. Popular advertising of special alloys of iron with a dash of this or that and a cryptic name should be viewed with suspicion until satisfactory tests under specific conditions of service are obtained. So far no low-priced iron alloy has been put on the market that seems worth the difference in cost except for atmospheric exposure, and ordinary Bessemer steel with a little copper seems to be at least as durable as any other for that type of service.

Fig. 1. New Tacoma Alkali Plant Photographed Under Construction in January, 1929

The Cell Room, 350 ft. long, is shown at the right; the office is in the center, and the shipping buildings are on the left. Projecting behind these is the structure of the caustic-soda building and evaporator house.

New Alkali Plant for the Pacific Northwest

ON FEBRUARY 16, 1929, the Hooker Electrochemical Company formally opened its new electrolytic caustic soda and chlorine plant at Tacoma, Wash. This development in the Pacific Northwest has been watched with interest by the chemical industry because it is evidence of the trend toward decentralization, in order to serve the chemical consuming industries in some of the newer industrial sections of the country.

The final choice of the particular location in Tacoma was due to a combination of an existing market demand and unusually favorable manufacturing facilities. The latter include convenient shipping by deep water and rail, a satisfactory power supply at a reasonable rate, and an economical 20-acre plant site. Inasmuch as liquid chlorine is mainly consumed in the manufacture of pulp and paper, a location convenient to the growing industry in the Northwest became essential from a distributing standpoint. The other main product, caustic soda, finds a large part of its outlet in shipments to foreign countries and to California, thereby emphasizing the necessity for deep-water shipping facilities directly from plant.

The new Tacoma plant has an initial daily capacity of 30 tons of 76 deg. caustic soda, and 26 tons of cell chlorine. The Townsend electrolytic cell, for which the Hooker Electrochemical Company owns the domestic and foreign patent rights, is used. The plant is equipped to produce liquid and solid caustic soda, liquid chlorine and synthetic muriatic acid made by combining the chlorine and hydrogen gases from the brine decomposition. Other chlorine products will be made as the demand in the West warrants expansion along the lines now followed in the Niagara Falls plant of the company.

Fig. 2. Unloading 8,000 Tons of Spanish Salt at the Company's Dock on the Hylebos Waterway

There are two docks, one of which is about 100 ft. long intended for loading of barges and small boats, and the other 300 ft. long for handling barge vessels. Dredging has recently been completed to give 35 ft. of water at low tide at each of the docks.

Power is purchased under contract from the City of Tacoma and originates at its large Cushman hydroelectric plant. In view of the fact that the plant is located on deep water, it is possible to receive salt shipments from ocean-going vessels as well as from those of coastwise type. Fig. 2 shows the SS. "Anglo Indian" which on December 12 discharged a cargo of 8,000 tons of salt that had been mined at Terrevieja, Spain. Special unloading, handling and storage facilities are provided so that the unloading of this cargo was accomplished at the rate of 1,000 tons a day. Steel storage tanks large enough to hold several months' supply of salt are also provided. The fresh water required is supplied from the Tacoma City water mains. Two centrifugal pumps each with a capacity for handling 4 million gallons per day have been installed to draw salt water from the adjacent Hylebos Waterway for condensation, steam and cooling purposes.

In a later issue *Chem. & Met.* will publish a detailed description of this plant, but some features of interest may be mentioned here. The building in which the Townsend cells are housed is 350 ft. long and is immediately adjacent to the power house. Two 2,000-hp. Westinghouse rotary converters supply direct current for decomposing the brine. Process steam is generated by two B. & W. boilers fired by mill waste of fuel oil. The general facilities of the plant include a two-story office, machine shop and a modern locker room. The plant was built by the Austin Company, and its architectural features were designed by McKim, Mead & White of New York.

The design and construction of the plant has been carried out by J. M. Rowland, chief engineer. J. A. Flynn is superintendent.

Estimating Heat Consumed in Batch Rectification of Alcohol

By Glen S. Houghland

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THERE is considerable information available in regard to the theoretical heat quantities involved in the fractionation of various liquid mixtures, but this information relates to fixed, constant compositions of vapor or liquid entering a system, and there appears to be very little published data in regard to its application to intermittent or batch rectification, in which conditions change continuously. So far as the writer is aware, the only information heretofore published in this connection is by E. Hausbrand (Principles and Practice of Industrial Distillation, translated by E. H. Tripp) in regard to columns with an infinite number of perfect plates, and the corresponding theoretical minimum reflux. Batch or intermittent rectification is extensively used in industry for the separation of a great variety of materials, and, as will be shown later, average heat consumptions for columns of definite numbers of plates are extremely useful to the still designer or production engineer.

A method has been evolved for determining the average theoretical heat consumption for intermittent rectification in apparatus of the general type shown in Fig. 1, and the method has been applied to the concentration of ethyl alcohol from aqueous solutions having initial concentrations of 1 to 20 per cent, producing distillate containing 92.46 per cent alcohol, exhausting the residue to 0.1 per cent alcohol, columns of 9 to 16 perfect plates, and also of an infinite number of perfect plates.

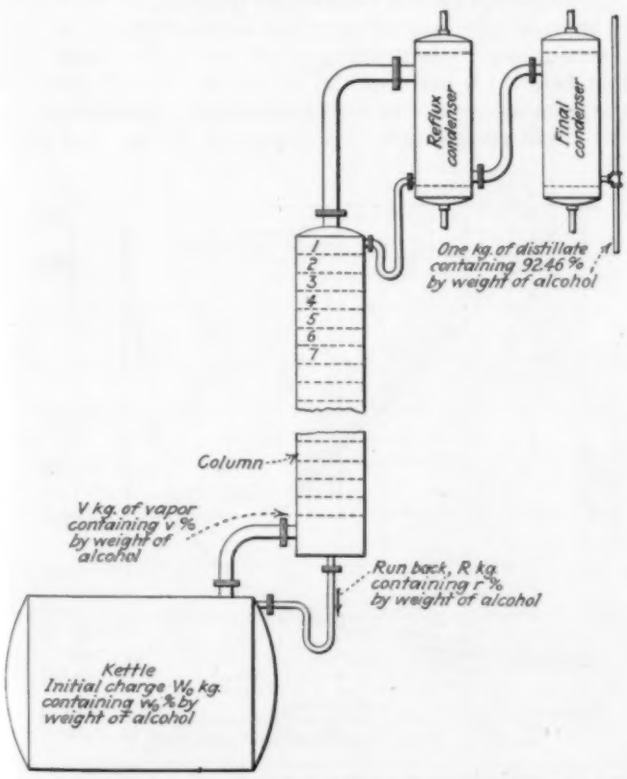

Fig. 1—Apparatus for the Intermittent Rectification of Alcohol

For the distillate producing period of intermittent rectification, the total heat consumption is the summation of the heats at each instant of the run. This was determined from the area under a curve obtained by considering a charge of definite initial concentration and weight, and by plotting the weight of distillate produced against the the theoretical instantaneous heat consumption at various stages of the run. The total heat consumed divided by the total distillate produced gives the average theoretical heat consumption per unit weight of distillate.

In order to ascertain the heat consumption applying at the instant when a given weight of distillate has passed over, it is first necessary to determine the composition of the residue left in the kettle at that instant. This is easily calculated from the weight and initial composition of the charge, and from the weight and composition of the distillate distilled therefrom, by the following equation, assuming and neglecting a small ratio of liquid in the column to the liquid in the kettle:

$$w_1 = \frac{w_0 W_0 - dD}{W_0 - D} \qquad (1)$$

where

W_0 = initial weight of charge
w_0 = initial concentration of alcohol in charge
W_1 = weight of residue left in kettle
w_1 = concentration of alcohol in residue left in kettle
D = weight of distillate produced
d = concentration of alcohol in distillate

With the composition of the residue in the kettle known, the composition of the vapors arising therefrom and entering the bottom of the column may be easily determined from tables of liquid-vapor equilibrium. The theoretical heat quantities involved at the instant when a given weight of distillate has passed over may then be calculated by known methods, (W. K. Lewis, *Jour. Ind. & Eng. Chem.*, V. 14, No. 6, p. 483), or taken from tables, and these values may be plotted against the weight of distillate produced to give the curve, the area under which represents the desired total heat consumption. In using tables such as are given in Hausbrand (*ibid.*), which give the composition of liquid and vapor on each perfect plate when different amounts of reflux heat are used, any one plate as for example, the 9th plate from the top may be assumed to be the bottom plate of a column. The next plate below this in the table, in this example the 10th plate from the top, then represents the

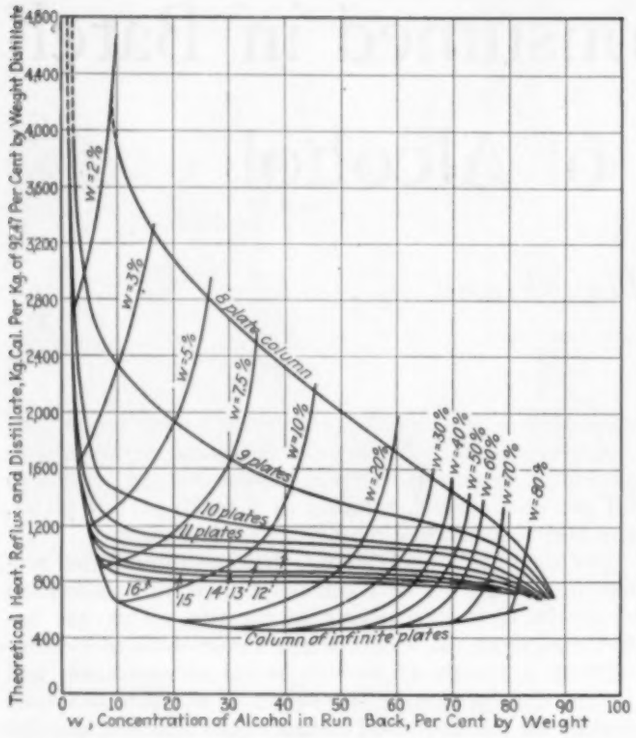

Fig. 2—Intermittent Rectification of Alcohol with Theoretical Perfect Plate Columns
w = Concentration of alcohol in kettle per cent by wt.

kettle; the liquid on this plate being of the same composition as the liquid in the kettle, and the vapor arising therefrom the same as rises from the kettle to pass into the bottom plate of the column. The liquid on the bottom plate of a column comprising the assumed number of plates, then is of the same composition as the run back to the kettle from the column. The instantaneous heat values used in the data here presented were plotted in this manner from Table 13, in Principles and Practice of Industrial Distillation by E. Hausbrand.

The instantaneous heat values so obtained were supplemented by additional values obtained by plotting the data from the table in a different manner, together with other theoretical data, in order to provide additional points facilitating extrapolation. In Fig. 2, one set of curves was plotted from the table referred to above, the heat values being ordinates, and the abcissa being the corresponding compositions (r) of liquid on the bottom plate of the column, which liquid is of same composition as the run back to the kettle. For greater convenience in applying final results, the heat quantities have been converted to kg.cal. per kg. of distillate of 92.46 per cent alcohol, and they include both the reflux heat and the latent heat of one kg. of distillate, amounting to 239 kg. cal. The compositions (w) of the liquid in the kettle corresponding to compositions (r) of run back, are established by the fact that at any given heat level the composition (r) of run back from a column of a given number of plates equals the composition (w) of liquid in the kettle corresponding to a column containing one more plate. Points of equal compositions (w) of liquid in kettle were thus established, and curves including these points were drawn in Fig. 2. This same set of curves representing equal values of (w) may also be plotted from points obtained by calculating the weight and latent heat of vapor entering the column (equal to combined heat of reflux and distillate) corresponding to various assumed values of run back compositions (r). Weights and compositions are related by the following equations:

$$V = R + D$$
$$vV = rR + dD$$

from which

$$R = \frac{dD - v}{v - r}$$

where:

R = weight or run back
r = concentration of alcohol in run back, per cent wt.
V = weight of vapor entering column
v = concentration of alcohol in vapor entering column
D = weight of distillate
d = concentration of alcohol in distillate

These equations were employed in extending the curves of Fig. 2 representing equal values of (w). The curve for a column of infinite plates (in which case, w = r), was also calculated and plotted from the above formulae. Intersection points of the two sets of curves in Fig. 2 give theoretical heat reflux and distillate for definite compositions of liquid in kettle and in the run back. These points provide additional values to be used in plotting instantaneous heats against weights of distillate.

For greater accuracy, two sets of curves of instantaneous heat values at intervals of the run have been plotted, assuming initial charges of 1.0 and 20 per cent alcohol, and exhausting to 0.1 and 1.0 per cent alcohol respectively, as shown in Figs. 3 and 4. The weight of the initial charge in each case was arbitrarily chosen to be just sufficient to provide 100 kg. of 92.46 per cent distillate with complete exhaustion of the charge. In each of the two figures referred to, one curve is shown representing the concentration (w) of alcohol in the liquid in the kettle as calculated from equation (1), which is necessary to locate the weight of distillate at which the instantaneous heat values are to be applied.

It will be noted from Fig. 2 that the instantaneous heat consumption for columns of 9 plates or more tend to approach the heat consumption for a column of infinite plates at low concentrations of alcohol in the kettle, and that below 1.0 per cent the curves are for all practical purposes identical. In Fig. 3, therefore, representing intermittent rectification of a charge of 1.0 per cent alco-

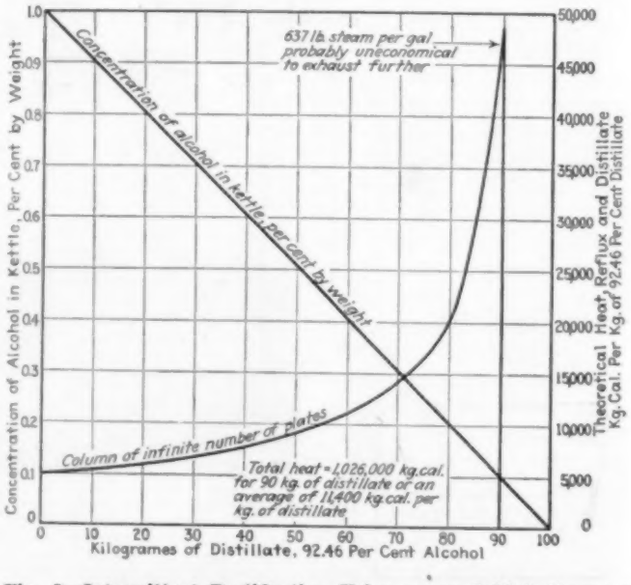
Concentration of Alcohol in Kettle, Per Cent by Weight
Theoretical Heat, Reflux and Distillate Kg.Cal. Per Kg. of 92.46 Per Cent Distillate
Kilograms of Distillate, 92.46 Per Cent Alcohol
637 lb. steam per gal. probably uneconomical to exhaust further
Concentration of alcohol in kettle, per cent by weight
Column of infinite number of plates
Total heat = 1,026,000 kg.cal. for 90 kg. of distillate or an average of 11,400 kg.cal. per kg. of distillate

Fig. 3—Intermittent Rectification Using as an Initial Charge a Water Solution Containing 1 per cent Alcohol

hol, the instantaneous heat values applying to column of infinite plates only is shown, the data obtained from the area under this one curve being applied to columns of 9 plates or more. Exhaustion of the charge is assumed to be carried to the point where the residue contains 0.1 per cent alcohol, at which point the heat consumption is 48,000 kg.cal. per kg. of 92.46 per cent distillate, equivalent to 637 lb. of steam from and at 212 deg. F. per gallon of distillate. If steam costs $0.50 per M, the cost of steam at this point of the run is $0.32 per gallon of distillate, and further exhaustion of the residue is probably not good economy.

The final results comprising the summation of instantaneous heat consumption divided by the weight of distillate to give the average heat consumption are presented by curves in Fig. 5. These curves indicate the theoretical average heat of reflux and distillate for the production of one kg. of 92.46 per cent by wt. alcohol from initial charge of from 5 to 80 per cent alcohol, by intermittent rectification with columns of 9 to 16 perfect plates, and with a column of infinite plates.

Data on steam consumption is frequently useful in estimating boiler requirements of new installations, or in effecting power economies in existing installations. In the absence of actual steam measurements, the necessary steam supply may be approximated from the theoretical data, assuming that the perfect plate columns are equivalent to actual columns of about double the number of plates. This applies to the distillate producing period of intermittent rectification. The steam required to heat the charge to its boiling point must be calculated separately from the weight and specific heat of the charge.

During intermittent rectification, the vapors passing through the top part of the column will contain a high percentage of alcohol throughout the run, and the latent heat this vapor (neglecting radiation losses) equals the latent heat of the steam supplied from the steam coils, which also equals the latent heat of the vapors condensed in the reflux and final condensers. The velocity of the vapors passing through the top part of the column is therefore directly proportional to the rate of steam consumption, or to the combined heat of reflux and distillate. In the case of ethyl alcohol, the velocity of vapors will be approximately the same in all parts of the column, as equal amounts of heat vaporize approximately equal volumes of water or alcohol. As the capacity of a column is limited and established by the maximum velocity that will not cause priming, it follows that heat consumption will be held fairly constant throughout the run, and that the average capacity of the column will be approximately inversely proportional to the average heat consumption per unit weight of ethyl alcohol distillate.

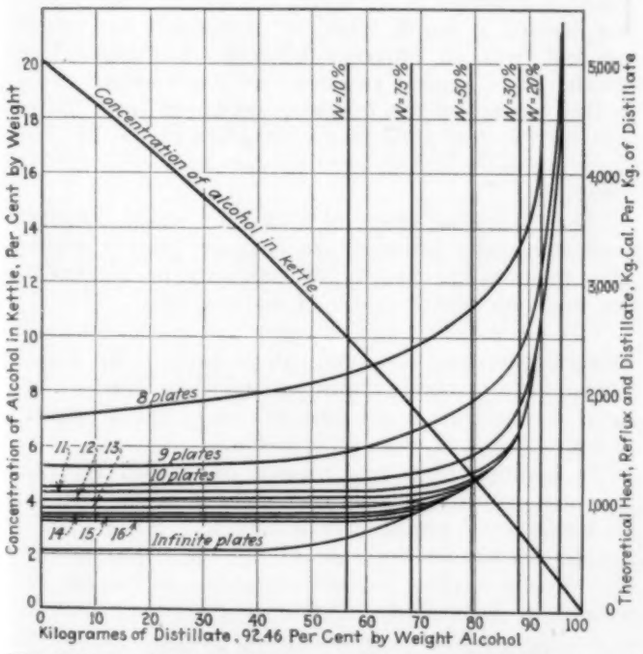

Fig. 4—Intermittent Rectification Using as an Initial Charge of Water Solution containing 20 per cent Alcohol
Distillate, 92.46 per cent by weight of alcohol.

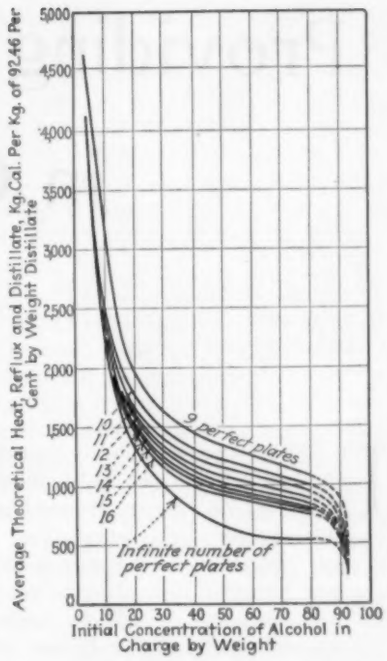

Fig. 5 — Intermittent Rectification of Alcohol. Average Heat (Theoretical) for Reflux and Distillate
Distillate, 92.46 per cent by weight of alcohol. Residue exhausted to 0.1 per cent alcohol.

The maximum load on the last or final condenser may be calculated from the average capacity of a still, the average heat consumption for the run, and the instantaneous heat consumption at the instant when the run begins. For example, it is required to find the capacity at the beginning of a run of a column containing 15 perfect plates, the initial concentration of alcohol in the charge being 40 per cent by weight. From Fig. 5 the average heat consumption applying to this case is 1,050 kg. cal. per kg. of distillate, and according to calculation heat consumption at the beginning of the run when the concentration of alcohol in the kettle is 40 per cent, is 810 kg. cal. per kg. of distillate. The capacity of the column at the beginning of the run is therefore 1,050 ÷ 810 = 1.3 times the average hourly capacity, and the final condenser should be capable of handling 1.3 times the average hourly rating of the column.

It has been assumed in all cases that the run shall cease when the residue in the kettle has been exhausted to 0.1 per cent of alcohol at which point the heat of reflux and distillate is 48,000 kg. cal. per kg. of distillate. Since the heat of one kg. of distillate amounts to 239 kg. cal. the heat of reflux at this point is 48,000—239=47,761 kg. cal. per kg. of distillate, and the reflux condenser is therefore called on to handle at this point 47,761 ÷ 48,000 × 100 = 99.5 per cent of all of the vapors leaving the column. The average heat of reflux and distillate of 1,050 kg. cal. per kg. of distillate, applying to the case at hand, is equivalent to the heat of 1,050 ÷ 239 — 4.4 kg. of distillate per kg. of distillate produced. Since heat is assumed to be supplied to the column at constant rate, if the capacity of the column is one kg. per hour, the total vapors passing from the column to the reflux condenser amount to 4.4 kg. per hour, of which at the end of the run the reflux condenser must condense 99.5 per cent, or 4.38 kg. times as much as the average hourly capacity.

Providing for Patent Obsolescence in Chemical Industry

By F. P. Byerly

Price, Waterhouse & Company
Philadelphia

IT SEEMS reasonable to consider as within the scope of this subject not only obsolescence of intangible processes or patents themselves, but also of related special machines and other plant facilities. As is well known, processes are often found to be unpatentable or are not patented for obvious reasons of policy, hence, in this discussion it will be understood that the word "processes" generally indicates processes not covered by patents.

Processes and patents are usually acquired by an industrial corporation in one of the following three ways:

(1) Discovery, invention, or development by the company's own staff (chiefly, of course, the research or experimental departments).

(2) Purchase for cash or equivalent.

(3) Acquisition by issuance of securities, e.g. capital stock of the company.

In the first of these three cases it will often, if not usually, be found that the cost of the process or patent has not been capitalized on the company's books but has been absorbed in the current expenses of the research, experimental and legal departments. Attempts have been made to segregate the cost of successful research and experiments from that of unsuccessful research and experiments, with a view to capitalizing the former and amortizing it against the cost of operation or production under the process or patent developed, treating only the cost of unsuccessful work as current expense. In practice, however, it has been found impossible to make this distinction satisfactorily, one obvious reason being that, particularly in the chemical industry, a line of research or experiment may be commenced with one objective in view but may result in a discovery of some commercially useful fact that was totally unexpected when the work was undertaken. Other cases have, of course, occurred where a number of interesting facts have been developed by a course of experiments and a distribution of the total cost to the various bits of valuable information derived would only be arbitrary.

ANOTHER difficulty in applying such a method of bookkeeping arises from the continuance of a line of research sometimes over a period of several years, whereas for financial and tax purposes the accounts must be closed at least once a year; thus at any closing date there may be a considerable amount of expensive research work in progress which cannot be designated at the time either as successful or as unsuccessful. It is believed that for companies in the chemical industry the soundest and most practicable method of treating research and experimental work in the accounts is as an item of expense, with the qualification that cases have arisen and will no doubt continue to arise where a company not yet well established and without any large amount of available surplus is justified in treating definite investigations in progress as a deferred charge to future operations.

The expense of the experimental and research department should be controlled by budgetary methods. Not only should the total amount of the appropriation for the work of this department be determined by the Board of Directors or Finance Committee in advance of each fiscal year, but the appropriation be sub-divided so far as possible as to the lines of research and experimentation to be carried forward during the year; frequent reports may be required from the executive head of the department to keep the Board of Directors or responsible committee currently informed as to the progress and outlook for each investigation. The extent of the supervision exercised by the Board of Directors or its Committee may vary considerably among well-managed concerns, dependent upon whether or not the Board has members with personal knowledge and experience in the field of chemical research and whether or not the executive head of the department is viewed by the Board as being a practical business man as well as a chemist of high standing.

LARGE concerns in the chemical industry have recently deemed it worth while to distinguish for operating and financial purposes between "fundamental research" and "applied research" or experimental work. In this connection the following quotation from the report for the year 1927 by the president of the Du Pont Company to the stockholders appears to be of timely interest:

"The diversified chemical industries which constitute your company's business are basically closely related. This relationship consists of similarity or identity of raw materials and processes of manufacture.

"The more far-reaching changes and improvements in chemical processes and products go back to the fundamental facts in chemical science and have usually come about through the application of fundamental research to the problems of chemical industry.

"In addition to a vast amount of applied research, your company has always carried on a certain amount of fundamental chemical investigation. Since it is so essential to the development of the art, it has recently been decided to place increased emphasis on fundamental research. Accordingly, additional equipment essential to this type of investigation is being provided from time to time as the need arises, and a personnel especially adapted to carrying on investigations of this nature and

selected with particular reference thereto, has under investigation definite problems in the category of fundamental research.

"The proper conduct of fundamental research of this nature furnishes added assurance of consistent progress, making available to our applied research information of prime importance not otherwise obtainable."

In line with the foregoing policy it is understood that far-sighted concerns in undertaking a program of fundamental research are departing from the old method of adjusting the research appropriation annually dependent upon the amount of available profits from the previous year and are taking steps to provide that each year for a considerable time an appropriation for this work will be made of an amount at least sufficient to permit the scientific personnel of the organization to be retained intact so long as they render satisfactory services. Scientists have shown a reluctance to relinquish agreeable connections with universities of learning in order to devote themselves to industrial work, even at considerably higher salaries, unless assured of reasonable continuity and permanency of work in the latter field.

WHERE applied research or experimental work is carried on for the definite object of bettering a particular class of product or processes or to develop the use of more economical processes or raw materials, the cost of such definite lines of investigation may well be charged to the manufacturing overhead of the department to which it relates, in this manner including the specific investigation in the cost of the department's product. Here again it might seem justifiable to treat the cost as a deferred charge against future operations, but since there must always be a considerable uncertainty as to the success of the investigation, conservatism if not theory makes it preferable to absorb the expense in current costs of production.

Since, as above explained, the cost of discovery, invention, or development of processes and patents by a company's own staff will in conservative practice usually not be capitalized at all in the accounts, there is of course no specific provision to be made for obsolescence, as such, of the processes and patents. It may be said that the costs of research and experiments that are being currently charged to expense or manufacturing costs are in effect an anticipatory charge against earnings for obsolescence.

Although the processes and patents may be developed by the company's own staff, however, there will, of course, be carried as a plant asset item on the company's books the cost of special machinery, equipment, or other tangible facilities used to carry out the processes. These items should be written off or reserved against over any reasonably short period that may be advised by the company's technical staff, or even more rapidly if possible, in order to provide a margin of safety.

Our second case, i.e. where the processes and patents are acquired by a purchase for cash or equivalent, is on the whole the simplest of the three. Costs of patents purchased are conventionally and for income tax purposes amortized over the remaining legal life. This treatment in the accounts involves little difficulty except where a group of patents of varying individual expiration dates is purchased for a lump sum. Here it is necessary either to use an average remaining life, or better, to make a fair allocation of the total cost among the various patents using as a basis the best expert opinion available as to relative values.

If the company's technical staff advise that there is serious doubt as to whether the useful life will be as long as the legal life a more rapid amortization should be provided in the accounts for purposes of conservatism.

Occasionally, patents may be purchased not for use by the company but to rid it of an outside menace or possible nuisance. In such instances, if the amounts involved are not relatively large, it is conservative practice to charge off the expenditures as an expense of the business when incurred rather than consider the patents of any definite asset value.

Processes and relative physical equipment purchased should be amortized or reserved against, over what is the expected useful life, as determined by the concern's directors or executives on the basis of advice from the technical staff, due allowance being made for any substantial expected salvage value of the physical equipment.

The third case, viz: where processes or patents are acquired by the issuance of securities, particularly capital stock, presents some questions that do not appear to arise in the first two cases already discussed, athough the legal and accounting treatment is quite conventionalized and relatively simple. According to standard legal and accounting procedure, where the stock issued for such assets has a par value this value will ordinarily determine the amount at which the processes and patents are to be taken up on the books; and where the stock is of no par value the valuation determined by the organizers or Board of Directors upon authorizing the issuance of the stock will similarly be used as the ledger value of the assets. The principles by which the rate of amortization or provision of reserves for depreciation and obsolescence should be determined are the same as already outlined under Case Two.

In the acquisition for capital stock of processes and patents, as well as other classes of property other than cash or current assets, some economic questions are suggested upon which it may be of interest to touch.

ATTENTION has been directed by more than one writer to the obvious truth not generally enough recognized some years ago that economic wealth is divisible into two classes, namely: money, credit and so forth, on the one hand, and "utility" wealth on the other. The first class includes such items as cash, checks, credit, notes, bonds, mortgages, etc., and the second class such things as houses, ships, factories, patents, processes, and so on almost *ad infinitum*.

Utility wealth, from the standpoint of an industrial concern, may be classified into two broad divisions, the one consisting of commodities bought and sold in the ordinary course of business, which for practical purposes are normally tantamount to money since such goods are constantly being converted into money and money into such goods in more or less rapid alternation; the second consisting of capital goods, i.e., plants, processes, patents, etc., the economic value of which can normally be estimated only on the basis of reasonably expected earning power. Capital stock of a corporation usually represents a mixed aggregate of money wealth and utility wealth, but from the standpoint of an investor, as distinguished from a speculator, resembles capital utility wealth much more closely than it resembles money. Future earning power, especially of an enterprise based upon such a progressive field of science as industrial chemistry, can practically never be accurately forecast for any substantial period, either as to the amount of future annual money earnings or as to

the economic value of such money at the time it is expected to be earned.

A difficulty in keeping clearly in mind the broad distinctions between classes of economic wealth obviously arises from the fact that, from its very origin as a common denominator for goods traded in, the money or currency unit has come in practice to be adopted as a measure for all forms of economic wealth, and it will be readily seen that without such a generally recognized common denominator it would be practically impossible to prepare financial statements, compute income and other taxes, and compile business and economic statistics.

The fact, however, that substantial aggregations of capital assets in many cases cannot be accurately reduced to a money equivalent as at any one point of time for many years been given practical recognition by having the consideration paid by a corporation for the acquisition of such assets, especially upon organization or reorganization, capital stock instead of money, and such recognition has become more explicit in the last dozen years by the widespread adoption of stock without nominal or par value.

From an economic standpoint then, how can it be said that the proper charge against annual earnings for the depreciation or obsolescence of such assets can be definitely and accurately expressed in money, when the money equivalent of the economic value of such assets upon acquisition for capital stock is not itself susceptible of precise determination, (notwithstanding the fact already mentioned that the determination of a legal and relative bookkeeping valuation presents no great practical difficulty)?

In practice, as well as in theory, we are confronted with a further difficult question in attempting to prepare, for purposes of financing or reorganization, accounting statements which include depreciation or obsolescence charges computed in such manner as fairly to reflect past and proven earnings to be taken by prospective investors as a guide to future earning power. For industrial concerns, no more direct or practicable means of accounting for depreciation and obsolescence has been found than that of prorating the cost of original valuation of capital assets over their expected useful life. It cannot be plausibly contended, however, especially as regards periods of wide and general fluctuation in price levels, that depreciation charges on this basis are appropriate in connection with forecasts of future earnings from the security holder's standpoint.

PURPOSE of depreciation provisions is to maintain intact the capital of the enterprise so far as that capital is represented by plant, processes, patents or other wasting assets. But this seemingly simple requisite presents three questions none of which is susceptible of a precise answer: firstly, what is the measure of the capital to be maintained?, secondly, what is the period of remaining useful life?, and, thirdly, what will be the cost of replacement with facilities of equivalent economic value?

For an answer to any of these questions as to plant assets of an industrial concern an appraisal by the once popular method of making a more or less accurate computation of the current cost of reproduction new and deducting "observed depreciation" is often an unreliable guide. It is not infrequently found that this method takes inadequate cognizance of earning power, and, among other things, largely ignores obsolescence of specialized types of facilities due to changes in the art or to the development of competing products, as well as changes in the economic suitability of location due to changes in labor markets, markets for materials or products, transportation costs, tariffs, tax burdens, etc. It thus appears that the chief significance of an appraisal at current reproductive cost is to afford a measure of the financial barrier to but one of many potential means of competition, viz. the erection of a practically identical plant in the vicinity, and thus to indicate only a *maximum limit* of economic value, (barring cases of abnormal emergency demands for products, notably such as occurred during the World War, where the time element is so important as to make a completed plant of even greater value than the cost to replace it physically by an identical property).

While it may appear that the latter part of foregoing discussion tends rather to confuse than to clarify the treatment of the problem suggested by the title of this paper, it is nevertheless hoped that some practical purpose may be served if these somewhat rambling comments should prove to be provocative of further thought and research regarding the limitations of certain conventional concepts. It is becoming recognized today that a close relationship necessarily exists among accounting, financial, and economic problems, and, as in the field of industrial chemistry itself, old ideas must constantly give way to new as result of unceasing study and criticism.

Stainless Iron Drums for Nitric Acid Shipment

In a paper presented by W. M. Mitchell before the American Society for Steel Treating, in Philadelphia, October 8 to 12, 1928, he pointed out that it was extremely difficult to produce drums constructed of iron-chromium alloys that could be depended upon to meet specifications imposed by the Bureau of Explosives and the Interstate Commerce Commission.

Recognizing the greater toughness and ductility of welds made on the austenitic chromium-nickel alloys of the "18 and 8" analysis, experiments have been made with drums constructed from this metal, and these have been found to pass all varieties of the drop test which could be devised.

Drums of various sizes, usually 15, 30, and 55 gal. capacity have been constructed of No. 14 U. S. Gage sheet, and provided with stainless cast or forged flanges and bungs. While they are admittedly high in cost they should last indefinitely with reasonable care, and this is certainly not true of the highly fragile glass carboys.

Chemical manufacturers are much interested in these drums and have been conducting tests for about a year. There is some question, as was to be expected, regarding resistance of the "18 and 8" analysis to all grades of acid. The chemically pure acid apparently attacks slightly, or at least to such an extent that some discoloration of the acid results after storage in the drums. This is undesirable, and unless means can be found to remedy this, a different composition perhaps—it may not be possible to use drums for this grade of acid. In addition, one or two failures have occurred in the welds after some months in service. But as these drums were among the first made, it is believed that when welding technique is further perfected stainless drums will take the place of the carboys now used, at least for certain grades of acid.

READERS' VIEWS AND COMMENTS

An Open Forum

The editors invite discussion of articles and editorials or other topics of interest

Who Owns the Results of Government Research?

To the Editor of Chem. & Met.:

Sir:—Your editorial in the December issue on patents resulting from Government research and also the account of the conference on the general subject in the same issue, would seem to indicate that history is repeating itself and that the same variations in viewpoint which existed regarding the Act of Congress of March 3, 1883 are becoming evident in relation to the Act of April 30, 1928.

This act remits patent fees to a Government employee when two conditions are fulfilled: He must absolve the Government from paying any royalties to him under the patent and the Head of the Department concerned must certify that the invention is in use or likely to be used in the public interest. The first condition is not mandatory for all government employers under all circumstances—only if that employee desires a remission of patent fees. But the second condition laid down in the Act of April 30, 1928, is not mandatory in any case. Even if an invention is used or likely to be used in the public interest, there is nothing to compel the Head of a Department to fall in with the desires of a Government employee and make such certification. That certification is an optional administrative act pure and simple and any number of reasons may cause a careful administrator to decline to make such certification under certain conditions. One perfectly good reason would be that the Government already has a clear title to the patent to be issued for a device because of the circumstances under which the invention was conceived and developed. In such case the inventor would not pay the fees incident to obtaining a patent, either, but he has no commercial rights beyond what everyone else would have. He has whatever renown is attached to being the originator of the idea, plus what financial reward a grateful Government (through the medium of its administrators) desires to bestow. For the Navy Department, for instance, the mechanism for making this reward is supplied by the so-called "Beneficial Suggestions Act," of Congress approved July 1, 1918.

Should there be any Department or activity of the Government without funds allocated for the purpose of paying requisite patent fees for the purpose of obtaining patents to which it has a clear title, the lack can probably be remedied by requesting the necessary legislation.

Finally, suppose a head of Department, through inadvertance, makes the certificate required by the Act of April 30, 1928, and the patent issues. There is nothing in that Act, nor in any other grant by the Patent Office, to prevent the courts of the United States from finally vesting the title in that patent where it rightfully belongs, once the question is placed before them.

I believe it is clear that industry has nothing to fear from the recent Act of Congress relating to patents to Government employees. As indicated in the recent conference at Washington, a Governmental policy applying to all branches of the Government would do much to obviate confusion. But where title in a patent is improperly held, there is nothing in all the Acts of Congress so far, which nullifies in the slightest degree the legal precedents determining ownership as between employer and employee. And where title to a patent is properly held, in law and equity, by a Government employee, no one in industry or out should begrudge him the rewards, financial or otherwise, that are his due.

Washington, D. C. ALFRED G. ZIMMERMAN.

* * * *

Wonders of the West

To the Editor of Chem. & Met.:

Sir:—Perhaps you have not yet been edified by the intelligence contained in a recent letter to me, with which I favor you below. DR. RICHARD MOLDENKE.

Watchung, N. J.

Ælium

The Perfect Affinity of Metals
Laboratory: 832-40 North Spring Street
Los Angeles, California

Mr. Richard Moldenke,
Watchung,
New Jersey,

Dear Sir:

A new mineral has been found in which we feel you will be greatly interested. This mineral is called Ælium and is used in its native form. It is basic. We have proven that Ælium

Will hold lead in suspension in copper or cast iron.
Will fuse lead and copper with any metal.
Will change the structure of all metals.
Will add to the tensile strength of any metal.
Will increase the conductivity of copper and aluminum.
Will aid metal to flow at lower temperatures, thereby allowing intricate moulding of high melting metals.
Will not add or detract from the weight of metals.
Is handled in the ordinary procedure and necessitates no additional equipment.
Is the perfect affinity of metals because

All Fusions Remain Constant.

A sample of the mineral with a formula will be forwarded gladly upon request. We court your most severe tests.

Very truly yours,
ÆLIUM COMPANY.

P.S. In a test yesterday a piece of steel having the hardness of 12 on Rockwell scale was covered with Ælium and a reducing flame applied. The steel then showed a hardness of 66. Result: an ideal welding rod.

Gaudeamus Igitur

World map just received. Without doubt the finest work of its kind yet produced. Congratulations on a good job well done. (Telegram.)

C. C. CONCANNON

Chief, Chemical Division,
U. S. Dept. of Commerce,
Washington, D. C.

Your January issue contains a very instructive map showing distribution of chemical engineering industries throughout the world. I would like to have an additional copy so that I may frame it.

Permit me also to offer my congratulations on the very excellent issue of this month. H. J. MASSON

In charge of Chemical Engineering,
New York University,
New York City.

I think your world map of the Chemical Engineering Industries is fine but I notice that the big salt deposit on the Gulf of Chihli at Tientsin is not indicated. The Chinese consider this a very important deposit.

JAMES R. WITHROW

Professor of Chemical Engineering,
Ohio State University,
Columbus, Ohio.

The information in regard to chemical raw materials and manufacturing facilities in your map is exceedingly interesting and is very useful to us in connection with various War Department studies. G. A. RANKIN

Office of Chief of Chemical Warfare Service,
Washington, D. C.

Your wall chart giving a world perspective of chemical engineering industries is certainly interesting. The eighteen small maps are particularly interesting to Pennsylvania chemists. Do you realize that in nine of the eighteen maps, Pennsylvania has ten per cent or more of the production? In five others it has five to nine per cent and in only four of the eighteen does it fall below five per cent of the total. FRANK C. WHITMORE

(Recently appointed Dean, School of Chemistry and Physics, Pennsylvania State College)

Northwestern University,
Evanston, Ill.

This (map) is an excellent piece of work and you are to be complimented on bringing this information together in such usable form. I should like to get two more copies in a form that could be mounted for a permanent record. W. CLIFFORD WITHAM

Department of Chemical Engineering,
University of Delaware,
Newark, Del.

Your January issue is more attractive to me than any of your special numbers. I especially like your equipment review. The fellow who wrote it did an excellent job. I also liked Mr. Tyler's article and I was able to get some good research ideas out of the advertisements.

DONALD B. KEYES

In charge of Chemical Engineering,
University of Illinois,
Urbana, Ill.

Congratulations on your splendid review number. Good articles, indispensable statistics, a fascinating map and altogether—a long look ahead for the industry!

THEODORE M. SWITZ

Investment Research Corporation,
Detroit, Mich.

Combination of Old Steps Gives Valid Process Patent

IN THE CASE of the Merrell-Soule Company *vs.* Northland Dairy Company, which had been appealed to the U. S. Circuit Court for the Sixth Circuit, a decision recently delivered by Judge Denison held that the spray drying process and equipment patents of the former company were valid and infringed and therefore ordered an accounting.

The Merrell-Soule patents 860,929 and 1,000,931 cover a process consisting of two steps: (1) Evaporating part of the water from the raw milk in a vacuum pan, and (2) spraying the residue through a current of dry air, thus removing the remaining moisture and obtaining dry powder as a product.

The opinion states that each of the two steps were old in the art, but that the patentee was the first to employ them together, and that by so doing he was enabled to obtain a better powder, at less cost, than was obtainable by either method alone. The conclusion reached by the Patent Office in allowing the process upon that set of facts was therefore held proper.

A process of making sugar (Stauf's patent No. 666,-711), consisting in evaporating the juice in a vacuum pan and dropping the sticky residue through a current of hot air which removed enough of the moisture so that some crystals formed, was held not sufficiently analogous to patentee's process to be anticipatory.

Patent Claims Held Too Broad To Be Valid

CLAIMS 3 and 7 of patent 1,597,233 for an accelerator for the vulcanization of rubber were held too broad and too general to be valid by a decision in the case of Albert C. Burrage et al. *vs.* Roessler & Hasslacher Chemical Company in the District Court for the District of New Jersey.

In this patent, issued to Burrage August 24, 1926, he claimed the discovery of phenylorthotolylguanidine and that it was an excellent rubber accelerator. The claims in suit were as follows:

> 3. That process of vulcanizing rubber characterized by heating rubber and a vulcanizing agent with phenylorthotolylguanidine.
>
> 7. A vulcanizable compound comprising rubber, a vulcanizing agent, and phenylorthotolylguanidine. . . .

The defendant, as an alleged contributory infringer, manufactured and sold this compound to the rubber industry. The defense was that (1) Morris L. Weiss had made the invention as early as August 8, 1921; (2) and that there is no invention in view of the prior art; and that (3) claims 3 and 7 are too broad to be valid in that they are mere observations and are based upon insufficient disclosure.

Judge Bodine's decision sustained the defense in reference to the Weiss application. He declared further:

> It is also apparent to me from the examination of plaintiff's expert that POTG was not an invention in view of the prior art. I make no claim to understand chemical formulae, but the plain intent of his testimony is to the effect that by substituting one methyl group in DPG instead of two, POTG results; that as a chemist he could tell that the structure would be basic, and that he would expect it to be an accelerator.
>
> As to the claims in suit, they seem too broad and too general to admit of validity.

CHEMICAL ENGINEER'S BOOKSHELF

Hydrogen-Ion Determination

THE DETERMINATION OF HYDROGEN IONS. By *W. Mansfield Clark*. 3rd edition. The Williams and Wilkins Company, Baltimore, 1928. XVI + 718 pages. Price, $6.50.

Reviewed by J. LIVINGSTON R. MORGAN

Perhaps no book on chemistry in recent years has been accorded such a ready reception by such a large scientific public as was this book in its previous editions; and certainly the names of few authors have become so completely identified with their subject, in the minds of that public, as is the case here. For this book presented for the first time the technique of hydrogen-ion determination, that subject so vital in chemical, industrial, biological, physiological and medical research, in one clearly written, authoritative volume; with the result that today the expressions "hydrogen-ion determination" and "pH value" have become practically synonymous with the name Clark, in the thoughts of numerous investigators and students.

This third edition, which is completely rewritten, is on a broader, more philosophical, more fundamental foundation than the others were, and has been considerably expanded both from the experimental and theoretical sides. From the experimental viewpoint this is especially to be noted in the treatment of the optical aspects, quinhydrone and related half-cells, metal-oxide and glass electrodes, and in the chapter on applications; while from the theoretical side new chapters appear on changes of free energy, temperature coefficients, the theory of Debye and Hückel, on alternate methods of formulating acid-base equilibria, elementary theory of titration, and on non-aqueous solutions. All tables in the new edition have self-explanatory titles, which aid the reader materially; and the notation is in accord with the usage of the International Critical Tables.

This indeed is a book which should have a place on the "handy" shelf of the book case of everyone who is interested in physical chemistry in general, and which should be the constant companion of everyone who is determining hydrogen-ion concentrations, or is employing them.

* * * *

Science in Foundry Practice

ELEMENTARY FOUNDRY TECHNOLOGY. *Lawrence A. Hartley*, Editor. McGraw-Hill Book Company, New York. 423 pages. Price, $3.

Reviewed by RICHARD MOLDENKE

Foundrymen of America, interested in the training of apprentices to transmit the art of founding to coming generations of molders, have been waiting for this book. It has been a long while coming, but all expectations have been realized, and it is now possible for the larger individual foundries, or groups of the smaller ones, to arrange for apprentice instruction under the care of home talent and build upon reliable and fundamental information such as this foundry textbook gives. Further, the foundry foreman, the technical staff, the office men and executives will find sufficient of basic information here to concentrate more effectively on the production of good work.

The chemistry and physics of matter are so closely interwoven with the foundry phenomena that the student is first inducted into the study of the structure of substances and the changes they exhibit when affected by the forces of nature. From the application of force, the mechanics of fluids, power, etc., the instruction narrows down more specifically to the chemistry of iron, and then to its production practically. The student is thus informed on the raw materials he has to deal with in getting ready to produce iron castings.

Special chapters are now given on the cupola and its successful operation; on mixture-making; foundry sands and their control; and on the field of the electric furnace in the foundry. Eight chapters on the art of molding, with full information on modern methods of machine molding, complete the technical portion of the book. A copious glossary of practical foundry terms and a very complete index increase the usefulness of the treatise as a class textbook as well as a work of reference.

This book is commended to all those who wish instruction in foundry practice given in plain language and right up to date. It is very complete, and the student will have nothing to unlearn when subsequently putting up molds, melting iron, or designing cast-iron constructions.

* * * *

Manufacture of Pulp and Paper and Its Materials

THE MANUFACTURE OF PULP AND PAPER, Vol. IV, Second Edition. *J. N. Stephenson*, Editor. McGraw-Hill Book Company, Inc., New York. 260 pages. Price, $6.

Reviewed by A. E. BUCHANAN, JR.

It is just about ten years ago that the project of publishing a complete, up-to-date and practical treatise on modern methods of pulp and paper manufacture was conceived by a joint meeting of the educational committees of the Technical Section of the Canadian Pulp and Paper Association and the Technical Association of the (U. S.) Pulp and Paper Industry. The reception accorded the first edition, in five volumes, gave ample justification for the tremendous task and, it is hoped, some measure of reward to the broad-visioned paper experts who gave liberally of their precious time in writing and reviewing manuscripts. The relatively short time since the first appearance of these industrial text-books has witnessed unprecedented activity in scientific and engineering research in the pulp and paper industry. For that reason Volumes IV and V have been completely overhauled, modernized and revamped, placing the whole subject of paper machines in Volume V (not yet published) and grouping in Volume IV the general subjects: Preparation of Rags and Other Fibers; Treatment of Waste Papers; Beating and Refining; Loading and Engine Sizing; Coloring and General Mill Equipment. New features appearing in the second edition of Volume IV include sections on the generation and use of steam,

paper-making details and hydrogen-ion concentration. Sections on coated papers and rosin sizing have been entirely rewritten.

A glance over the names of the collaborators in this volume is sufficient guarantee of its technical accuracy and comprehensive scope for the list of authors and editors is almost a roll-call of the men of outstanding distinction in each field. The fact that those most capable of doing this work were also quite willing to do it is a tribute at once to their earnestly sympathetic attitude toward educational effort in the industry and to the technical associations which crystallized their effort. The work is thus equally admirable in conception, in execution and in presentation. Volume IV is not only one of the finest of industrial textbooks but it is also a veritable "bible" on the phases of papermaking of which it treats.

Even if frequent reference had not depreciated most first editions of Volume IV to the replacement point, the new edition would be a good investment in "modernization."

READING LIST ON PAPERMAKING MATERIALS. By *Clarence J. West*. Published for T.A.P.P.I. by Lockwood Trade Journal Co., Inc., New York, 1928. 239 pages. Price, $3.

Among technical and professional associations, T.A.P.P.I. is unique in the effectiveness of its functioning by the committee method. And of Tappi's many committees concerning themselves with practically every phase of the pulp and paper industry, none has been more consistently productive than the committee on Abstracts and Bibliography, headed by Dr. Clarence J. West, Director of Research Information Service, National Research Council. The first edition of this book was published as contribution No. 23 of Dr. West's Committee and was reprinted and issued as Bibliographic Series No. 6 by Arthur D. Little, Inc., Cambridge. In this second edition the literature has not only been brought up to date but many additions have been made to the earlier work. New references to many of the woods used in paper making are given, especially from the work of Wills and Rice of the Forest Products Laboratory. Hardly a plant exists which has not been considered as a paper-making material. By thus assembling references to these experiments, the compiler has set up sign posts which will guide those who would explore ground which has already been surveyed and condemned.

References are drawn from 175 sources, in several languages. Materials are listed alphabetically with both popular and botanical names given. This scholarly work may be fairly rated as a distinguished addition to the literature of pulp and paper.

* * * *

Experimental Organic Chemistry

LABORATORY EXPERIMENTS IN ORGANIC CHEMISTRY. By *Roger Adams* and *John R. Johnson*. The Macmillan Company, New York. 304 pages. Price, $1.90.

Reviewed by HARRY F. LEWIS

As an addition to a long list of organic laboratory guides this useful book strikes one as being exceedingly well done from a mechanical standpoint, despite its modest price. What regards subject matter, the arrangement falls into two major portions: Part I deals with experiments involving experience in laboratory technic with complete theoretical discussion included on accompanying pages. Part II contains forty experiments dealing with the preparation and reactions of typical organic compounds. An appendix is included containing the approximate times required for the various experiments, physical properties of some uncommon organic compounds, vapor pressures of organic substances and water, and a list of materials and reagents required for units of ten students.

A number of features are apparent to one using the book in class. The descriptions of experiments are full and complete even in regard to such factors as the amounts of wash and crystallizing solvent to be used. This helps for successful student operation as the reviewer can testify from use of the book in an organic class. When possible the products of one preparation are used in the next; witness the series butyl alcohol—butyl bromide—butyl cyanide—valeric acid and benzene — nitrobenzene — aniline—acetanilide—bromacetanilide. Use of butyl derivatives in place of the corresponding ethyl derivatives is to be commended. Required apparatus is simple and is such as will normally be found in most organic laboratories.

The influence of the connection of the authors with the checking and editing of "Organic Syntheses" is to be seen in the various preparations. Because of the common use of newer methods and reagents, it is rather surprising to find aniline prepared by the action of tin and hydrochloric acid. One would expect that the more recent general method involving the use of iron activated with a trace of acid would find a place. This is however a small matter and does not detract in any way from the general excellence of the book.

* * * *

Functioning of Enzymes

ENZYME ACTIONS AND PROPERTIES. By *Ernst Waldschmidt-Leitz*. Translated and extended by *Robert P. Walton*. John Wiley and Sons, Inc., New York. 255 pages. Price, $4.

Reviewed by WILLIAM C. MOORE

Possibly no better idea of the scope of this valuable book on enzymes can be obtained than by quoting from Dr. Walton's preface: "The material within this volume constitutes a general treatment of enzyme action and properties as interpreted principally from the viewpoint of the Willstätter school."

The first 100 pages constitute a general section, covering such topics as "Development of the Ferment Concept," "Enzymes as Colloids," "Enzymes as Electrolytes," "Enzyme Kinetics," "Enzyme Reaction Systems," "Enzyme Specificity," and "Detailed Procedures in Preparative Enzyme Chemistry." The latter portion of the book is devoted to a "Special Section" in which brief accounts are given of the behavior and properties of all the more important enzymes. This part of the book alone will make a strong appeal to most workers in organic and biochemistry.

From the standpoint of the general reader who has a fair knowledge of enzyme chemistry without having specialized in it, the book is well written and clearly presents the salient features of the present status of our knowledge of enzymes. This reviewer found the subject matter so fascinating that he was loath to lay the book aside after he had started to read it, and was momentarily interrupted.

An important feature which will commend it to those who wish to use this work for general reference purposes, is the care with which original sources of information are given. In fact, very few of the 241 pages of text are without journal citations.

So much for the general excellent qualities of the book. However, as King Gama in "Princess Ida" declared, "Life is extremely flat, with nothing whatever to grumble at." So it is with books—the review of a perfect one might perhaps be extremely dull. This, therefore, would seem to be a good place to do what little grumbling must be done. In the first instance, there are several examples of slip-shod proof reading, which, no doubt, will be corrected in later editions. Moreover, in a work of this type more care should be given to cross references in the subject index than is here immediately evident.

A great improvement in the orderly presentation of the subject matter would be effected if the whole of Chapter VII, in the "General Section," were introduced earlier, preferably immediately after Chapter I. While this might require the rewriting of the first six pages of Chapter VII, yet this change would strengthen the sequence of material leading up to the excellent discussion of "Enzyme Kinetics" in Chapter IV, which by the way, is one of the best sections of the whole work. This particular Chapter IV is strongly recommended as worthy of careful study by all who are interested in enzymes and in the related branches of science.

After closing the book and considering it in retrospect, one can feel nothing but admiration for the enormous amount of knowledge which workers in the field of enzymes have accumulated in relatively few years and with rather meager tools; and in giving such a clear readable and understandable account, of this work, Messrs. Waldschmidt-Leitz and Walton have rendered signal service to the chemical profession.

* * * *

Storage Batteries

STORAGE BATTERIES. By *Morton Arendt*. D. Van Nostrand Company, New York. 1928. 285 pages. Price, $4.50.

Reviewed by HELEN GILLETTE WEIR

Since only one short chapter is devoted exclusively to Edison cells this book is essentially a treatment of the lead storage battery. The author's object, according to his statement, was to produce a practical work and in one respect, he has excelled. The chapter "Storage Battery Applications" is undoubtedly the best compendium of this information published.

Unfortunately, the work is characterized by great wordiness, repetition of the same material in different chapters and a surprising lack of regard for the intelligence of the reader. It is inconceivable that an adult evincing sufficient interest to read such a book would need to be told that a leaky jar might be detected by moisture at the base or that overheated contacts are discernible by touch.

The material presented has, on the whole, been well chosen. However, there is a tendency in stating manufacturing procedures to give working details as generally applicable which are usable only in particular processes. Also, the author has given several curves, notably, the hours of discharge plotted again the coefficient of usefulness of the positive plate, which show an abrupt change of curvature at a point. It is to be regretted that no data is given to support these as, in this respect, they contradict data from any other source.

Had the author condensed the book to half its volume, he would have more nearly achieved his aim of a useful source of practical information. It appears unlikely that anything important would have been crowded out.

On Trailing Chemical Information

CHEMICAL PUBLICATIONS: Their Nature and Use. By *Melvin Guy Mellon*. McGraw-Hill Book Co., Inc., New York, 1928. 253 pages. Price, $2.50.

Reviewed by JULIAN F. SMITH

At the age of eight, the reviewer contributed effectively to the loss of a debate on the relative usefulness of the horse and the cow. Placing Mellon's *Chemical Publications* beside Crane's and Patterson's *Literature of Chemistry*, he inquired mentally (as will others also) what could be the use of writing another one. But examination of the contents soon revealed that *Chemical Publications* and *Literature of Chemistry* are to users of chemical literature as are the horse and the cow to the human race. To say which is which would be drawing the analogy too fine; suffice it to explain by another analogy. Crane and Patterson have written a Baedeker of chemical literature; Mellon has written a college geography of the same domain. That is, *Chemical Publications* is a college text, based on the course taught by Dr. Mellon at Purdue. It takes the student in logical sequence from the origin and development of chemical literature, through the sources to be consulted, to the procedure for making searches. Sources are classed in two groups, original and secondary, according to whether they contain new matter (including discussions of known matter) in which the information may be called unorganized, or compilations of known matter in organized form. In the presentation of original sources, separate chapters are devoted to periodicals, institutional and government publications, patents and miscellany (including dissertations and manufacturers' bulletins). In the presentation of secondary sources, separate chapters are given to abstract and review periodicals, bibliographies and reference works (including monographs and textbooks). The chapter on searching gives not only general instructions (use of libraries and card catalogs, classification systems, etc.), but also specific instructions for ten different types of searches.

Any one who studies this book thoroughly, by himself or in class, will have laid the necessary foundation for acquiring skill in the use of chemical literature. Printing, binding and typography are up to the usual McGraw-Hill standard. A suggestion for a future edition is to repeat the footnote references at the end of the book; they would form a useful bibliography.

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Industrial Chemical "Panorama"

INDUSTRIAL CHEMISTRY, An Introduction. By *Emil Raymond Riegel*. The Chemical Catalog Company, Inc., New York. 628 pages. Price, $9.

Reviewed by JAMES A. LEE

Primarily the intention of this book is to present in a single volume, a picture of the activities which make up industrial chemistry, and the second purpose is to serve as a class room text in the industrial chemistry course, such as is usually given to under-graduates in our colleges and technical schools.

The World War and the following economic conditions have been the cause of many new industries and many changes in chemical engineering processes. These changes have been so numerous as to make a book, written on the subject only a few years ago, obsolete. Ten years

ago, accelerators and antioxidants were unheard of in the rubber industry, nitrogen fixation and the rayon industries were in their infancy, while today they are enormously important. This period has seen the wood rosin industry develop, helium become popular for use in Zeppelins, neon for advertising display signs, the dye and dye intermediate industry grow in importance, pyroxylin lacquers used almost entirely for finishing automobiles, and chromium plating come into its own for corrosion and wear resistance purposes. In fact, processes are changing at such a rapid rate that, to keep up with the procession it would be necessary to constantly revise books on industrial chemistry.

We are therefore indebted to the author for giving us a more up-to-date text book on industrial chemistry than most of those to be had. Professor Riegel has treated the subject in an interesting manner and in the limited space of one volume has included much information of value to the student.

On the other hand he has used many references that are now out of date and has not included many of the most interesting recent developments in this branch of science, for example, in the chapter on rubber there is no mention of anti-oxidants nor is there sufficient information about reclaimed rubber, which has become so important in recent years. Similar omissions could be pointed out in many other chapters, such as the one on industrial gases, where neon's present importance is ignored.

* * * *

Studies on Metals

PHOTOMICROGRAPHS OF IRON AND STEEL. By *Everett L. Reed.* John Wiley and Sons, Inc., New York. 253 pages. Price, $4.

Reviewed by FRANK J. G. DUCK

Comprising, as it does, 214 pages of photomicrographs and but 39 pages of text, this work presents obvious difficulties to the reviewer. If he be of the school that believes in the "picture" method of education, it will please him; on the other hand, if he places his faith in the power of words, it may disappoint.

To this reviewer, it seems that the book would be of more value "to those interested in the production, in the treatment, and in the use (*of iron and steel*)" if there were a better balance between illustrations and text. In other words, although each photomicrograph is identified as to the chemical and micro-physical composition of the specimen, the treatment it has received, the etching reagent employed and the magnification used, the writer feels that a discussion of the advantages and disadvantages of the many specimens of iron and steel (and the treatments given them) would greatly enhance the worth of this work.

The photomicrographs, the majority of them excellent, are logically grouped under 18 major and 41 minor heads and are completely indexed in the table of contents, thus permitting ready location of any desired micrograph. Five appendices—standard practices in preparing, etching and photographing metallographic specimens; microscopes; and definitions of terms relating to metallography and heat treatment—are also included.

As a supplement to one of the more comprehensive treatises on the metallurgy and microscopy of iron and steel, this work will be of value to the student, the producer and the user of these most important of industrial metals. It is, of course, self-sufficient to the experienced metallographist.

A STUDY OF CHROMIUM PLATING. By *Richard Schneidewind.* Bulletin No. 10, Department of Engineering Research, University of Michigan, Ann Arbor, 1928. 141 pages. Price, $1.

Mr. Schneidewind has given us a second very valuable book on electroplating; this time he has collected under one cover a complete study of chromium in this application. He has presented his information so that it would be understood by executives and engineers interested in plating in a general way and by electrochemists. First there is presented a non-technical account of electrodeposited chromium and commercial methods for its preparation, followed by a detailed account of the original research done at the University of Michigan. The effect of bath compositions, nature of anodes, and plating conditions upon the results are taken up. The third part is a review of the scientific and patent literatures on the subject, and the book concludes with a bibliography and tables of data on the experimental work.

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METHODS IN NON-FERROUS METALLURGICAL ANALYSIS. By *R. Keffer* and *C. L. McNeil,* with *Alison Butts.* McGraw-Hill Company, New York, 335 pages. Price, $4.

Reviewed by G. D. VAN ARSDALE

Succeeding admirably in what they set out to do, the authors and editors of this book furnish a compendium of analytical methods for the commercial nonferrous laboratory. It is unusually complete in itself as covering practically all methods needed for such use; and it is gratifying and valuable to find also complete references to authoritative sources for details of specialties outside of the usual routine. The arrangement of the book is good and convenient; as the preface states, the chapter headings give a summary of methods and of the cases to which each is best adapted, thus enabling a choice to be made. This is followed by general methods, methods for special cases, methods for estimation of traces and for estimation if impurities in a metal or in substances in which the element in question is the major constituent. Sufficient detail is given under each method and notes as to possible sources of error and limits of accuracy are added when needed. The methods as stated are, for the most part, those in use in the authors' laboratory at Anaconda, hence they can be depended on in detail for the purposes stated. Teachers or students in advanced analytical courses should find the volume indispensable; it should certainly find a place on the bookshelf of every chemist interested in the lines which are covered. It is a pity that the untimely death of the senior author removed from the profession a chemist of the ability and promise shown in this publication.

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Diatomite, Its Occurrence, Preparation, and Uses. By V. L. Eardley-Wilmot. Mines Branch, Department of Mines, Ottawa, Canada. 182 pages, with map and numerous photo-micrographs. Price, 30 cents.

Index to A.S.T.M. Standards and Tentative Standards. To September, 1928. American Society for Testing Materials, 1315 Spruce St., Philadelphia, Pa. This is the first of the society's indexes that will henceforth be published regularly and separately.

The Chemical Age Year Book. Diary and Directory. 1929. Benn Brothers, Ltd., 154 Fleet St., London, England. 169 pages, containing annual reviews, extensive tabulated information, diary, and commercial directories for Great Britain. Price, $3.50.

Selections from Recent Literature

SPRAYING. *Chemiker-Zeitung,* Jan. 9, p. 33. In the Schlick nozzle for spraying liquids active rotation is imparted to the liquid, by a fixed or movable attachment within the nozzle, before the actual spraying. In a quantitative study it was found that as the pressure rose from 2 to 6 atm. the output rose from 0.45 to 0.78 lit. per min., average droplet size fell from 0.11 to 0.055 mm., drops per liter increased from 1,430 to 11,420 million, and surface area from 5,440 to 10,850 sq.m. Figures intermediate between these are given for sprays effected at 4 atm. Photographs of the sprays and photomicrographs of the droplets are shown. Experiments on electrical charge and ionization of droplets coming from the nozzle are under way.

CONTAINERS. Oskar Kron. *Chemische Fabrik,* Jan. 9, pp. 15-6. Tanks and vats made of standard steel or sheet iron plates, which can be demounted and set up as desired, in any feasible rectangular dimensions, have many advantages. A principal drawback has been the necessity of reinforcing the sides with wrought iron stays on the inside. This so greatly increased the corrosion hazard as to put an inconvenient limitation on the range of usefulness of these tanks. A new construction, using only outside reinforcements, has now been designed. The new tanks can be sprayed or otherwise coated on the inside, and can be built of light metal alloys if desired. A photograph and a diagram are shown.

STEEL UNDER STRESS. B. P. Haigh. *Chemistry & Industry,* Jan. 11, pp. 23-30. In the increasing use of alloy steels to replace mild steel in construction and equipment, not enough attention is being paid to the increased hazard of cracking under alternating or pulsating stresses. The smaller pieces used to attain a given static strength may be more liable to such failure than the larger pieces of mild steel required for the same static strength. In a study of this hazard, fatigue tests were made on a Woehler machine and on a Haigh machine. Both these testing devices are described and illustrated. Graphic comparisons are made for mild steel and some high tensile steels, the fatigue limits and yield limits being plotted on the same graphs. There is practical danger of fatigue only when the fatigue line falls below the yield line. The effect of structural features, such as curvature, drilled or punched holes, etc., must also be considered. The factor of safety which must be allowed for a drilled high tensile steel plate may, for example, be very much greater than that necessary for a drilled mild steel plate. Prediction is difficult in problems of this sort, but rigorous mathematical treatment is possible with a flat test piece having one hole accurately drilled, and alloys which give good results in such a test may be considered dependable just as reliance is placed on a properly tested mild steel. In general, it must be remembered that a larger factor of safety must be allowed where failure by cracking is possible than where the only failure will be by plastic yield.

ROTARY KILN TREATMENT. Hoffmann. *Metall und Erz,* Jan., No. 1, pp. 4-12. Low grade or complicated ores (particularly of Zn and Pb) can be economically treated in a rotary kiln for recovery of the metal content. The treatment consists essentially in reducing the ore with carbonaceous material and volatilizing the metal. The first thought was to adopt the kiln and procedure of Portland cement manufacture; but the action is essentially different in the two processes and the procedure must differ accordingly. Thus, in cement burning the preheating zone occupies 60 per cent of the kiln length and the calcining zone only 40 per cent; but in treating ores the preheating zone occupies only 20 per cent and the reaction zone 80 per cent of the kiln length. The early development of the method is traced, and the latest procedure is described. The kiln is 40 m. long and 2 m. in diameter. It is lined with chamotte bricks 20 cm. thick. It is electrically driven and has a capacity of about 4 to 5 tons of ore per hour.

CORROSION TESTER. W. van Wüllen Scholten. *Korrosion,* Dec., pp. 265-72. In the corrosion testing instrument which uses two smooth iron electrodes, the direction of current sometimes changes, i.e., the positive and negative electrodes reverse their relation to each other. It was found by experiment that the previous mechanical treatment of the electrodes has much influence. Cleaning with sand and water has no apparent effect; polishing with emery makes the electrode more negative, and filing the surface makes it still more negative. It is suggested that these treatments increase the solution pressure, thus increasing the rate at which ions pass from electrode into solution. Some aspects of this problem with respect to corrosion testing are discussed.

RUBBER LINED APPARATUS. A. Bresser. *Korrosion,* Dec., pp. 277-9. Resistance of Bresser rubber linings for chemical equipment has previously been reported with respect to acids, alkalies and the like. Tabulated experimental results are now given, showing loss or gain in weight and behavior of three grades of rubber lining with respect to organic solvents. These include isobutyl alcohol, propanol, butyl acetate, acetic ether, butanol, methyl acetate, acetone, acetone oil, ethylmethyl ketone, dichlorhydrin and some proprietary solvents. The tests were made with iron panels covered with one of the three lining recipes. Observations were made on weight change, color change and precipitation in the solvent, swelling and other effects in the rubber, and corrosion in those cases where the metal became exposed. Two of the three compositions proved to be quite unsuitable for use with organic solvents. The third showed a slight gain in weight in a few solvents (2.48 per cent in propanol, less than 1 per cent in acetone oil and ethylmethyl ketone) but in most solvents it showed no change in weight and very little loss in mechanical properties. This composition (recipe not given) is therefore recommended for lining containers where the metal is to be protected from contact with organic solvents.

BUCKET CENTRIFUGE. Carl Hütter. *Chemische Apparatur,* Jan. 10, pp. 2-5. A new centrifuge for high temperature work has been successfully designed. It is particularly suitable for separating mixtures of fused salts and the like. The material is whirled in 4 small buckets, made of infusible glass. With chrome nickel resistance it can operate at 600 deg. C.; with platinum resistance element, at 900 deg. C.; and experiments are under way to raise the upper temperature limit to 2,500 deg. C.

WEIGHING SYSTEMS. Karsten. *Chemische Fabrik,* Jan. 2, pp. 3-5. The latest and most practical weighing system for the chemical industry is to use the new switch scale, either as such or in a special construction designed for particular conditions. The tipping beam scale with loose weights is useful on loading platforms but does not find much favor elsewhere in chemical plants. A combination of the two types, i.e., a tipping beam scale with separate indicating attachment, has also some applications. Some typical installations of the switch scale are described and illustrated, e.g., for batch weighing and the like.

PIPE CORROSION. W. Beck. *Zeitschrift für angewandte Chemie,* Dec. 29, pp. 1361-6. Stray earth currents in the vicinity of electric railways operating on direct current are sometimes responsible for electrolytic corrosion of pipe lines. Stray current measurements have been made in clay, loam, sandy and rocky soils. Experimental corrosion tests closely resembled actual cases of underground pipe corrosion. Since there is a growing tendency for electric railways to change to alternating current operation, a study of corrosion probabilities near such lines was made. The situation is complicated by the fact that an alternating current line may give off stray currents by contact, by induction or by influence. For prevention the electric railways and pipe line owners will have to co-operate closely, and it is apparent that protection will be comparatively expensive. Experimental study is still under way.

WELDING. R. W. Müller. *Apparatebau*, Jan. 11, pp. 3-9. Electric and autogenous welding are complementary rather than competitive. The electric method, being comparatively newer, is still in a more active state of experimental development. Both a.c. and d.c. welding machines are used, each having certain advantages. The choice for any job depends on the conditions to be met. Some noteworthy cases of autogenous welding are described and illustrated. They include a steam distributor with 19 welded branch openings; Y dividers for high pressure pipe lines; a 15-ton pouring ladle for molten metal; large diameter pipe unions, etc. Photographs of tensile, twist and bending test pieces are shown, and a numerical table gives a comparison of the elastic limit, tensile strength, contraction, elongation and bending properties of original metal, autogenous welds and electric welds.

COKING. G. Schneider. *Brennstoff-Chemie*, Jan. 1, p. 8 and Jan. 15, p. 27. The development of the coking art is outlined and improvements in its technology are reviewed. Illustrated descriptions include the Still type of regenerative coke oven, in which the combustion gases alternately burn high over one-half of the wall heating surface and then fall down over the other half. A noteworthy modern improvement is the use of the self-sealing door on coke ovens. As oven size has increased, the number of charging inlets has been increased, to provide uniform distribution of the charge. The old wasteful wet quenching method is gradually yielding to dry quenching and recovery of heat energy from hot coke. Numerous patent references are cited.

Government Publications

Documents are available at prices indicated from Superintendent of Documents, Government Printing Office, Washington, D. C. Send cash or money order; stamps and personal checks not accepted. When no price is indicated pamphlet is free and should be ordered from bureau responsible for its issue.

Health Hazards in Chromium Plating, by J. J. Bloomfield and William Blum. Public Health Service Reprint 1245 from Public Health Reports, September 7, 1928. 5 cents.

Annual Report of the Commissioner of Prohibition, Fiscal Year Ended June 30, 1928. This gives the tables on alcohol which formerly appeared in the report of the Bureau of Internal Revenue. Issued as Treasury Department Document 2998.

Statistics of Fats, Oils, and Oleaginous Raw Materials. U. S. Department of Agriculture Statistical Bulletin 24. 15 cents.

Imports of Certain Chemicals, Last Six Months, 1928. Mimeographed statistical summary issued by the Bureau of Foreign and Domestic Commerce and the U. S. Tariff Commission.

Fluorspar; Potassium Permanganate; Sodium Silicofluoride. Reports of the U. S. Tariff Commission to the President of the United States, each with Appendix Proclamation by the President. Respectively 5 and 10 cents.

Alphabetical Index and Numerical List of United States Government Master Specifications, Promulgated by the Federal Specifications Board (Complete to June 30, 1928). Bureau of Standards Circular 371.

Reaction of Water on Calcium Aluminates, by Lansing S. Wells. A discussion of reactions and phase relations significant with reference to cement setting. Bureau of Standards Research Paper 34. 25 cents.

Coal, and Coke and By-Products Statistics. Bureau of Mines Mineral Resources pamphlets for 1926. 30 cents and 15 cents respectively.

Mineral Production Statistics for 1927. Separate pamphlets from Bureau of Mines on: Stone, by A. T. Coons; Manganese and Manganiferous Ores, by J. W. Furness; Silver, Copper, Lead, and Zinc in the Central States, by J. P. Dunlop and H. M. Meyer; and Iron Ore, Pig Iron and Steel, by Hubert W. Davis. 10 cents each. Chromite, by J. W. Furness; Barite and Barium Products, by R. M. Santmyers; Mica, by B. H. Stoddard; Clay, by Jefferson Middleton; Cement, by B. W. Bagley; Lime, by A. T. Coons; Magnesium and Its Compounds, by J. M. Hill; Arsenic, Bismuth, Selenium, and Tellurium; Sand and Gravel, by Estelle R. Phillips; and Gypsum, by R. M. Santmyers and Jefferson Middleton. 5 cents each.

Mineral Production Statistics for 1928. Preliminary mimeographed statements from Bureau of Mines on: By-product and Beehive Coke, Iron Ore, Slate, Lime, Manganese, Copper, Lead and Zinc Smelter Production, and Copper, Lead, and Zinc Mining. Also regional statistics for the United States and for the following individual states: Washington, Utah, Oregon, New Mexico, Nevada, Montana, Idaho, Colorado, California, Arizona, and South Dakota, Texas, and Wyoming.

Studies in Fractional Distillation of Crude Petroleum, by M. B. Cooke and H. P. Rue. Bureau of Mines Technical Paper 431. 15 cents.

List of Publications, Bureau of Mines, 1910-1928, with an Index by Subjects and Authors.

Summarized Data of Copper Production, by C. E. Julihn, Bureau of Mines Economic Paper No. 1 10 cents.

Commercial Possibilities in the Use of Synthetic Hydrocarbon Processes in the Gas Industry, by W. W. Odell. Bureau of Mines Serial 2903.

The Explosibility of Suspensions of Soap Dust in Air, by David F. Smith and F. A. Hartgen. Bureau of Mines Serial 2905.

Production statistics from 1927 Census of Manufactures in preliminary mimeographed form for: Sodium Compounds; Potassium Compounds; Nitrogen and Fixed-Nitrogen Compounds; Acids; Compressed and Liquefied Gases; Aluminum Manufactures; Ethyl Alcohol; Fertilizers; Rubber Goods Other Than Tires, Inner Tubes, and Boots and Shoes; Consumption and Stocks of Rubber Reported by Manufacturers Classified in the Rubber-Industries Group; Cordage and Twine, Jute Goods, and Linen Goods; Manufactured Ice; Clay Products and Nonclay Refractories; Cottonseed Products; Slaughtering and Meat Packing, Wholesale; Turpentine and Rosin—Crop Year Ended March 31, 1928; Wall Plaster, Wall Board, and Floor Composition; Bone Black, Carbon Black, and Lampblack; Manufactured Fuel; Cast-Iron Pipe; Tin and Other Foils, Not Including Gold and Silver; Collapsible Tubes; Explosives; and Pulpwood Consumption and Wood-Pulp Production.

Miscellaneous Publications

Zinc and its Corrosion Resistance. American Zinc Institute, Inc., New York. 82 pages. Price, $1 postpaid.—A compendious, informative booklet on the technical status of zinc, condensed from several hundred sources which are listed as a bibliography.

Study of the Failure of Concrete Under Combined Compressive Stresses. By F. E. Richart, A. Brandtzaeg, R. L. Brown. University of Illinois Engineering Bulletin No. 185. 104 pages. 55 cents.

Heat Transfer in Ammonia Condensers, Part II. A. P. Kratz, H. J. Macintire, R. E. Gould. University of Illinois. Engineering Bulletin, No. 186. 28 pages. Price, 25 cents.

Seamless Tubing, A Bibliography. By Victor S. Polansky. Carnegie Library of Pittsburgh. 78 pages.

Definitions, Nomenclature, Symbols and Units for Heat Transmission. Report of Committee on Heat Transmission. National Research Council, 40 West. 40 St., New York. 12 pages.

Atlanta From the Ashes. By Ivan Allen. Ruralist Press, Atlanta, Ga., 1928. 144 pages. A bound volume romantically descriptive of Atlanta's renascence.

Le Detroit des Grandes Aventures. The Guardian Group, Detroit. A sumptuous, though slender, tribute to Detroit's present importance; the illustrations alone would justify its publication.

Scheme for Identification of Piping Systems. Approved by American Engineering Standards Committee. American Society of Mechanical Engineers, 29 West 39 St., New York. 22 pages.

Stability of Metals at Elevated Temperatures. By Claude L. Clark and Albert E. White. Department of Engineering Research Bulletin No. 11, University of Michigan, Ann Arbor, Mich. 122 pages. Price, $1.

THE PLANT NOTEBOOK
an exchange for OPERATING MEN

Know Your Pipe Lines

By Fred Emmarr
Dayton, Ohio

Chemical plants consist, in the main, of a maze of pipe lines. Their operation comprises principally the opening and closing of valves. And after years of operation, with changes of personnel, it is very easy to lose the identity of seldom used lines unless they are thoroughly charted. Most plants have complete piping lay-outs in their engineering departments; but this is not enough. In case of emergency, it is absolutely necessary that the operators have very intimate knowledge of all pipe lines, as well as location and use of every valve. Operation should be almost mechanical or instinctive, without much delay in searching for the proper valve.

It takes time to learn such details through verbal instruction from a predecessor or foreman. No employee should be entrusted with responsibility for a plant operation unless he knows where every pipe line lies and what every valve controls. Therefore, flow-sheets or line diagrams for each plant unit, showing the layout of all piping and location of all valves, as well as directions of flow, should be framed under glass and suspended at convenient places in the plant for immediate reference and easy study.

Further than that, every fluid should have its conveying lines painted a distinctive color for immediate recognition. Every valve should be tagged with its use to avoid possible disastrous mistakes. Most plants have adopted standard pipe color schemes, but do not have piping diagrams available to the operators. These most valuable adjuncts, needless to say, permit the operators to work most efficiently and at the same time may prove equally valuable to the management and supervisors.

Curves for Oil Calculations

By L. G. Jones
Baltimore, Md.

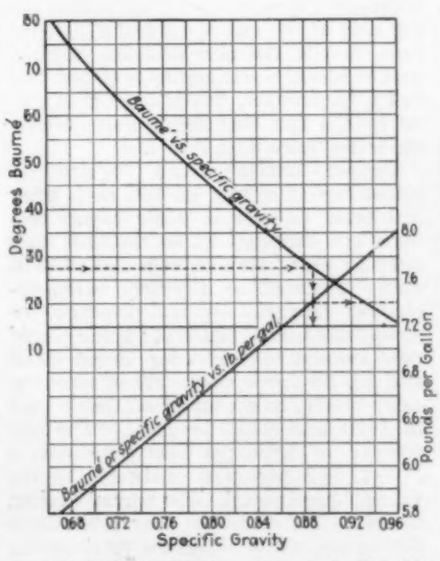
Practically all oils are bought on a basis of Baumé gravity reading as determined by hydrometers or pycnometers. However, actual volume and price units are based upon gallons usually, or barrels for extra large quantities. To convert the Baumé readings together with car-load weights to gallons usually represents a somewhat tedious calculation.

A Suggestion From the Editors

With this issue, the Plant Notebook enters its fifth year. The response of contributors has been generous, but the editors are anxious to see more new faces among the writers for this department. "Chem. & Met." will pay not less than $5 for any item accepted and proportionately larger amounts for longer articles. Suitable illustrative material is also desirable where it is appropriate.

Plant Notebook seeks to make your special plant methods, operating "kinks" and shortcuts more generally useful by passing them on to other chemical engineers in operation and production. The editors assume the responsibility of watching for ideas from other fields which may be useful to you; but it is to you, the men in the plants of the Chemical Engineering Industries, that the editors must turn for the type of article which is the backbone of the Plant Notebook section.

The attached curve short-cuts this operation, converting first from degrees Bé. to specific gravity on the upper curve, and then into lb. per gal. on the lower curve. Its use is best explained in the example given. An oil of 27.5 deg. Bé. is received. This is converted into specific gravity by determining the intersection of the 27.5 ordinate with the upper curve and finding upon the scale of abscissas, the value of 0.888 sp.gr. The intersection of this abscissa with the lower curve gives the lb. per gal. directly, which in this case is 7.4



Curves Tying Together Deg. Bé., Specific Gravity and Lb. per Gal. of Liquids Lighter Than Water

Eliminating Chemical Mist

By V. Zachert
San Francisco, Calif.

In certain chemical and electrochemical operations there is emitted a mist of corrosive solution charged with noxious fumes which is discharged into the atmosphere, causing not only loss of liquid and chemicals, but also injury to health and equipment.

This spraying effect is caused by the generation and disengagement of gaseous bubbles promoted by chemical or electrochemical action within the solution. These gas bubbles upon reaching the surface of the liquid are exploded by the force of surface tension, releasing the gas and simultaneously atomizing the solution in the form of a mist which then diffuses and contaminates the atmosphere.

In the metal working industry, in cleaning surfaces of oxide in acid pickle, the chemical reaction creates a spray of corrosive liquid which necessitates elaborate ventilating arrangements to maintain hygenic conditions.

This spraying effect is most prominent and disagreeable in the electrolytic deposition of chromium from chromic acid electrolyte and to a lesser extent in the electrolytic zinc plant.

In chromium plating the loss of solution due to dispersion by spraying attains considerable proportions and is of vital importance to the economy of the process. This atomization of the solution into the surrounding atmosphere can be minimized or eliminated by employing a method which will prevent the gaseous bubbles that are generated in the solution from collapsing and then exploding above the surface of the liquid.

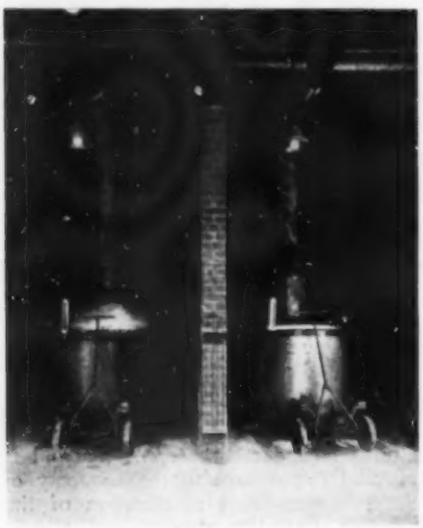
A practical means of overcoming this difficulty is to maintain a bed of froth or foam on the surface of the solution, thereby entrapping the ascending gas bubbles in a viscous mass. Once entrained in a body of froth the bubbles do not explode, but become entangled in the froth and there dispersed; consequently spraying of the corrosive solution into the surrounding atmosphere is completely eliminated.

The froth may be produced by introducing an emulsifying agent into the solution or electrolyte. As an emulsifying agent for producing froth in the chromium-plating bath, the writer used a minute quantity of eucalyptus oil with very satisfactory results. It is possible that the numerous frothing agents which are used for flotation of minerals in the flotation process of ore treatment would serve as satisfactorily as eucalyptus oil, but time did not permit a more exhaustive investigation.

Nickel Alloy Gives Increased Life to Varnish Kettles

A battery of 15 Monel metal kettles used for gum melting and for the bodying of linseed oil in the new varnish plant operated by Baer Brothers Company at Stamford, Conn., is showing several important advantages over the copper kettles commonly used for this purpose, according to recent information made available through a Nielsen survey. A life of 4,000 heats is regarded as a reasonable expectancy for Monel metal kettle bottoms and, on this basis, the savings effected in kettle costs, as shown by comparison with costs on copper kettles, will pay a net return of nearly 35 per cent per year on the added cost of the better material.

Another advantage of even greater importance, although not so susceptible to evaluation, is that the oil bodied in



Two Varnish Kettles in Operation in the Cook House of Baer Brothers Company

the Monel kettles is paler and of lower acid number than that cooked in copper kettles. This is explained by the fact that copper, being less resistant than Monel to attack by the free acids of the linseed oil, produces soluble copper soaps which cause a darkening of the oil and also tend to increase the rate of formation of free acids. Improvement in these features is of value in connection with the grade and brushing properties of the enamels which are produced.

The decision to use Monel for the kettles in this new plant was reached after examination of a Monel kettle which had withstood 2,500 hours of heating without noticeable deterioration. Since then, this kettle has had 1,500 hours more and is believed to be good for a considerable longer period of service.

The 15 kettles made for the Baer plant are of 175 gallon capacity, using 8-gage flat Monel bottoms and 13-gage cylindrical Monel sides. They are handled on cast iron trucks upon which they are mounted by means of lugs brazed and riveted to the sides. The cook sheds contain eight individually partitioned compartments for eight Gilbert radiant heat fires. These fires use oil at a pressure of 95 lb. and combustion air at 1½ lb. pressure. Combustion takes place in closed chambers below the floor level and the heat is transmitted to the kettles through an overlying course of firebrick. A fume disposal system eliminates the necessity for brick stacks.

Heats are made in batches of about 100 gallons consisting 95 per cent of linseed oil and 5 per cent of gum. The batch is brought to the polymerization temperature of 600 deg. F. as rapidly as possible, usually in 1 to 1½ hours. The mixture is cooked at this temperature for about 3 hours and then withdrawn from the fires for cooling to 400 deg. F. before removal from the kettles. During the cooking, it is frequently necessary to agitate the batch with long stirrers. Considerable scraping is necessary to secure the proper agitation and the kettle bottoms are subjected to some rather rough treatment.

The normal plant schedule calls for one batch per kettle per day, seven or eight of the 15 kettles being run in the morning and the remainder in the afternoon. The plant operates on this basis for about 275 days per year, handling about 400,000 gallons of oil annually. On this basis of 275 heats per kettle per year, it has been found that copper kettles require re-bottoming at 2 year intervals. The Monel kettles, however, on the basis of the service mentioned above, are expected to require re-bottoming only at the end of 15 years. Therefore, despite the fact that the original cost of Monel metal kettles is 40 per cent more than copper, this is more than offset by the fact that the former outlasts the latter more than 7 to 1.

Copper kettles would require re-bottoming at a cost of $60 each after 550 heats (2 years), while Monel bottoms are expected to be replaced only after 15 years' service, at a cost of $100 each. Reduced to a yearly basis, including depreciation and average interest, the annual totals per kettle would then amount to $16.84 for Monel metal and $37.65 for copper. This amounts, respectively, to a unit direct kettle cost of $.061 and $.137 per heat. The difference, or $.076 per heat represents a cut of 55.5 per cent creditable to the use of Monel metal. The annual saving, based on 275 heats per year amounts to $20.90 per kettle while the total saving during the nominal estimated life of 30 years for each kettle comes to $627 per kettle, more than ten times the additional cost of Monel over copper.

In addition to the question of price and the better color of the oil produced, Monel is found to give other advantages in the increased continuity of service and in the greater safety that may be expected. Copper bottoms are liable to sudden failure, either by dropping out of a part of the bottom or by having a stirring rod go through a weak spot. Records of the comparatively few failures of Monel metal kettles show that here the trouble is usually evidenced by small cracks from which the flow of oil is almost negligible Hence, complete loss of a batch is unlikely as is the danger of a troublesome conflagration. Also the ease of cleaning Monel bottoms is an advantage.

Projector in Position Over the Skylight

Floodlighting Building Interiors

The Austin Powder Company's plant at Glen Willow, Ohio, some of the features of which have been described elsewhere in this issue by Mr. Schmidt, has adopted a very unusual application of floodlights for lighting the interior of certain of the buildings where fire hazard is greatest. The accompanying illustration shows clearly how this was done. A section of the roof is made of heavy, corrugated wire glass which not only gives a good diffused illumination during the day but serves also at night when the floodlight, mounted on a pole above the roof, is turned on. The effect of the translucent glass is so to diffuse the beam from the projector that the interior lighting is excellent. It seems as if this system might well be used to light buildings housing other explosive or flammable hazards, particularly where breakage of a vapor-proof light bulb might ignite vapors. An additional advantage, of course, is that the one light serves both for the building interior and the surroundings.

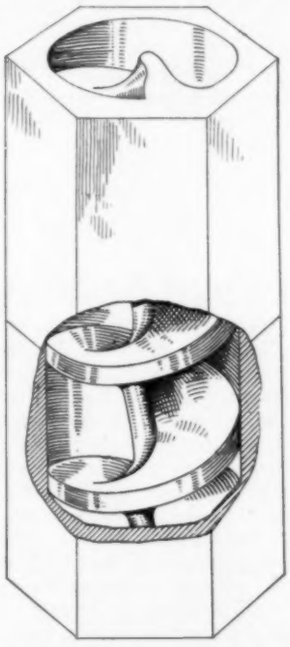
(Editor's Note:—A somewhat similar idea is used to illuminate the buildings of the Ford Motor Company's artificial leather plant.)

EQUIPMENT NEWS *from* MAKER *and* USER

New Spiral Packing

Andrew M. Fairlie, who has long been associated with the sulphuric acid industry, is the inventor of a new packing block which is now being manufactured by Maurice A. Knight, Akron, Ohio. The new block has a number of special features which warrant consideration. These include the use of a spiral interior member which winds, ribbon-like, about one edge as a center, eliminating the usual hole found through the middle of spiral packing rings. A second feature is the use of a hexagonal perimeter for the block instead of the usual ring shape. The third feature is that the spiral is so designed that its under side, as well as the upper surface, is kept wet by the liquid which courses through the packing.

It is pointed out that in packing a tower with the usual type of 3-in. spiral rings, the non-spiral areas represented by the center hole and the portion



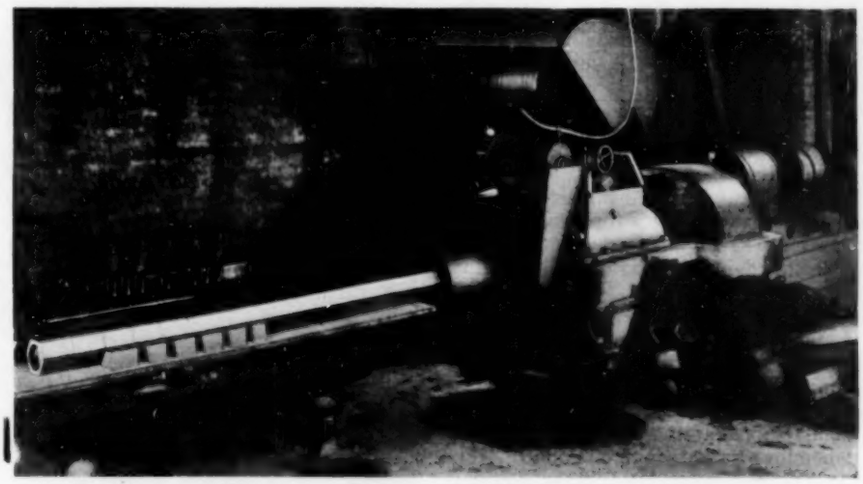
Cut-Away View of Two Hexahelix Packing Blocks

between three adjacent, touching rings, amount to about 20 per cent of the total tower area. As frequently stacked, this permits a straight-line flow of gas through these non spiral portions. The new block does away with both of these straight passages without material decrease in the free, effective cross-sectional area given by the usual type of ring. The radius of the interior spiral is one-half the inside diameter of the block so that the inner edge of the helical vein is at the center. The hexagonal exterior combines with the helix inside to form the name of the block, "Hexahelix."

When the blocks are packed in the tower, each block is surrounded by the six others which touch each flat side, giving a honeycomb arrangement. On this account, all gas and liquid must follow the helical course. This feature is said to assure superior mixing as well as greater travel for the same height.

The blocks are extruded through a die, in which a slotted core revolves to form the spiral. The twisted ribbon which results has a slight slope toward its inner edge so that part of the downflowing liquid slides over the edge and wets the under surface, increasing the wetted area.

The block is said to be composed of a high grade, acid-proof stoneware, and is now available in sizes of 4 and 6-in. widths and 4, 8 and 12-in. lengths. Weight of the 4x4-in. size is 2 lb. and 3 oz. per block, with 27 blocks per cu.ft. The total surface of a single unit is 120 sq.in. and the net cross-sectional area for gas passage is 7.72 sq.in. The effective free space is 59 per cent of the gross volume, and the effective free cross-sectional area is 48 per cent.

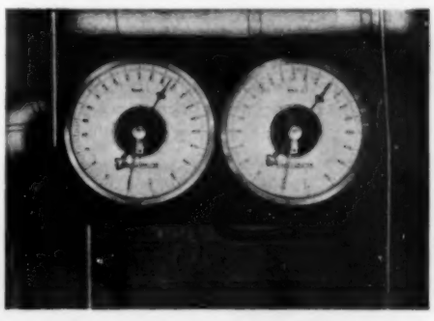


One of the Special Machines for Extruding Hexahelix Blocks

Remote-Reading Liquid Level Gage

A product recently introduced by the Liquidometer Corporation, Skillman Ave. and Hulst St., Long Island City, N. Y., is a distant-reading tank gage made in a number of different models. This gage employes a float consisting of a cylinder, long in proportion to its diameter, pivoted at its center point. This is mounted on the end of an arm which is pivoted at a fixed point, midway between the possible upper and lower levels of the tank liquid. A linkage, connecting with the arm, greatly reduces the motion of the float and communicates it to a balanced hydraulic transmission. The latter is one of the principal features of the device and to it is credited, largely, the instrument's ability to give accurate results at a distance up to several hundred feet from the tank.

The transmission consists of two pairs of metal bellows, each pair connected by small copper lines filled with a non-compressible liquid. Two bellows are located at the tank and the other two, connected by the copper lines to the first, within the indicating or recording instrument. Any motion of the float expands one bellows while it compresses the other at the transmitting end by an equal amount, so that the corresponding



Installation of "18-in. Senior" Liquidometers

pair of bellows in the indicator reflect the change. Any change in the volume of the transmission fluid due to temperature variation is ingeniously compensated in the indicator mechanism. The latter converts the differential motion of the two indicating bellows into rotary motion of the indicating pointer which moves on the face of the instrument. Through the use of the dual transmission systems, motion of the pointer is positive in both directions and an increase of pressure in one system is balanced by a decrease of pressure in the other.

Industrial Liquidometers are provided in a number of sizes, all of which use the same mechanism but provide different dial faces and types of cases. Sizes range from a 24-in. dial indicator to an industrial type with a total pointer travel of 10 in. The same mechanism is installed in two models of recording gages.

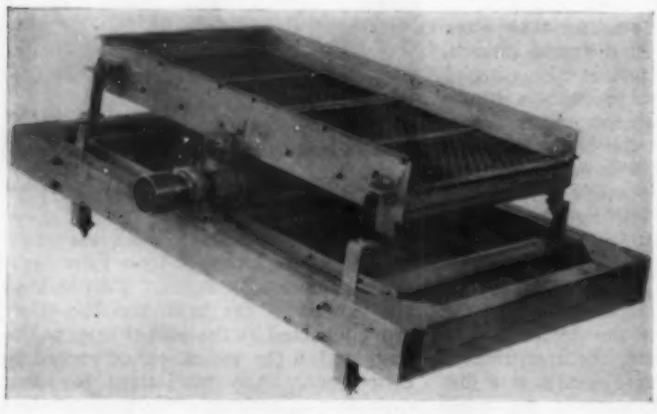
Two models of direct-reading gages employ a number of the same features. Instead of using the hydraulic transmission, however, motion of the float is communicated directly through a flexible metal bellows (this motion consists of a bending rather than a collapsing of the bellows) to the indicating mechanism. One model is a vertical-reading and the other is a flush-horizontal type.

All liquidometers are adapted for use on tanks which may be either under pressure or under vacuum. At the same time, parts subject to corrosion are provided in special materials to meet any need in the chemical engineering industries. Special facilities are available for producing dials calibrated for any tank size or shape.

Balanced Vibrating Screen

A departure in vibrating screens appears in the new Telsmith Balanced Vibrator placed on the market by the Smith Engineering Works, Milwaukee, Wis. As shown in the illustration, two screen decks are caused to vibrate simultaneously and in opposite directions through opposed eccentrics running in ball bearings and mounted on a heavy shaft between the two screens. Both ends of each deck are supported by compression springs.

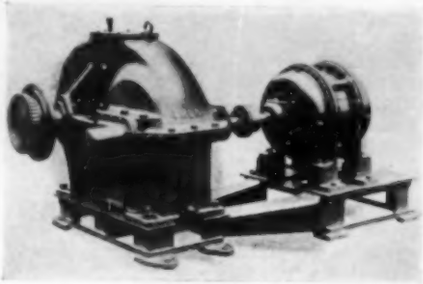
The feature of opposed motion of the two screening surfaces is said to result in greatly decreased vibration transmitted to the frame and driving mechanism. At the same time a vigorous and uniform vibration of both screen surfaces is maintained. Screen cloth is furnished in standard renewable trays which are readily replaceable.



Balanced Vibrator Showing Two Decks and Operating Cams

Welded Motor Bed

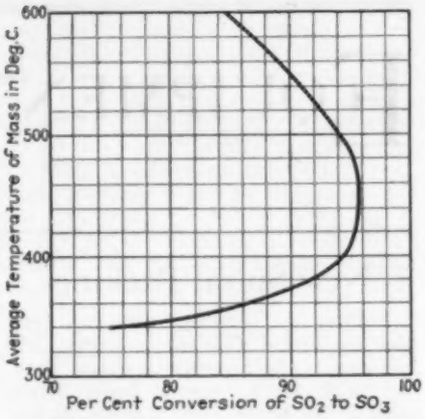
The accompanying illustration shows one of a complete line of welded steel motor beds, which has been placed upon the market by the Falk Corporation of Milwaukee. The manufacturers claim that the use of a welded steel bed is frequently an advantage over the use of a cast iron bed because of the greater strength and lighter construction of the former.



Welded Steel Motor Bed Produced by the Falk Corporation

New H_2SO_4 Contact Mass

The Silica Gel Corporation, Baltimore, has recently announced the successful use of Silica Gel as a base for a platinum contact mass to be used in the contact sulphuric acid process. Due to the relatively enormous surface area exposed in the pores and capillaries of Silica Gel, it is said that the quantity of platinum required is materially less than that normally used when the base is asbestos or magnesium sulphate. If the SO_2 gas is of 6 to 7 per cent concentration and is passed through the converters at the preferred rate of 0.32 cu.ft. per lb. of mass per minute, a conversion of 96 per cent or better is said to be obtained. In addition, the plant may be operated at a 50 per cent overload without lowering the conversion percentage more than about 1.5 per cent. It is claimed there is no appreciable loss in conversion efficiency with any clean SO_2 gas up to a concentration of 7½ per cent sulphur dioxide.



Performance Curve of Silica Gel Contact Mass Used in Converters of the Davison Chemical Company

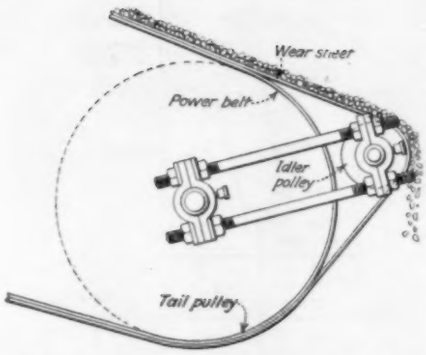
While moisture is normally removed from the burner gases, its presence has been found to have no effect upon Silica Gel mass. At the same time, the mass is insensitive to arsenic poisoning. It has been found that a plant using this material in its converters is easy to control and its operation is very uniform. As is shown in the accompanying curve, a high conversion rate may be obtained over a rather wide temperature range, contributing materially to the stability of the plant.

In regard to the ability of the new contact mass to maintain high efficiency on overload, an example is noted from one of the daily report sheets of the Davison Chemical Company. This contact plant has a normal capacity of fifty tons of 98 per cent acid for 24 hours. On the day under consideration the output was 69 tons with an average conversion for the two lines of 95 per cent.

Centrifugal Air Separator

An improved centrifugal air separator, known as model 27, has been put out by the Rubert M. Gay Company, 114 Liberty St., New York. This machine incorporates an improved centrifugal fan giving higher efficiency, it is claimed, with greater capacity and more rapid adjustment than was found in earlier models. Adjustment, it is further maintained, may be made so fine as to give variations of 0.1 per cent in mesh. These adjustments may be logged and returned to at any time.

Machines are available in sizes ranging from 30 in. diameter to 18 ft. with capacities up to 50 tons or more per hour. This is obtained at meshes ranging from 60 to 350. Construction is heavy, particularly in the larger models. The oiling system, claimed as another feature, supplies lubricant to the bearings continuously, filtering the oil as it leaves the bearings, cooling it and returning it to a reservoir without the use of a pump. A fixed scoop projecting into a reservoir in the fan hub serves to lift the oil. Particular attention has been paid to accessibility, and to the ease of adjustment.



Use of Separate Wear Sheet in Duplex System of Conveying Reduces Necessary Drop of Discharged Material

Duplex Conveyor System

The Boston Woven Hose and Rubber Company, Cambridge, Mass. is responsible for the introduction of a new system in belt conveying which is known as the Duplex system. In brief, it consists in the super-position of a wear sheet or pad upon the conveyor belt, whereupon the latter serves merely to transmit power while the wear sheet carries the load and takes the abrasion. The wear sheet is made in various thicknesses up to 1 in. depending upon service. It is manufactured from pure gum stock with two plies of duck, one located at the face next to the power transmission belt and the other at the center. This construction permits extreme flexibility of the belt while at the same time preventing stretch.

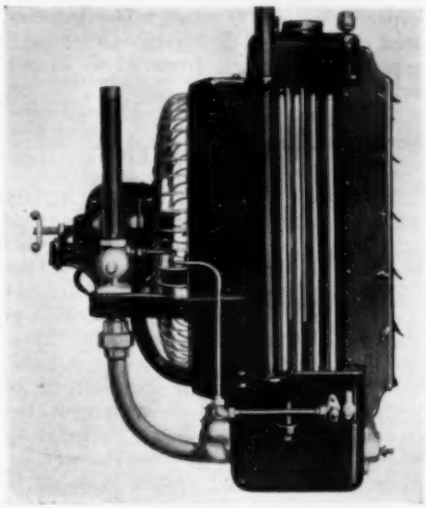
It is obvious that the wear sheet, as it is transported through frictional engagement with the power transmission belt, need not be under any working tension. For this reason, as well as for the reason that the belt is largely rubber, its life is said to be greatly in excess of the ordinary style belt when used for both power transmission and load carrying. The power transmission belt itself, as it need stand no abrasion when the wear sheet is used, is said to outlast three wear sheets on the average. These two economies, despite the higher cost of the wear sheets, resulted in savings in one installation of about 33⅓ per cent in conveying cost over the previous installation which used standard 6-ply rubber covered belt alone.

In some kinds of conveying it is very desirable to reduce breakage, as for instance, in handling hot coke. Use of the wear sheet permits this as it is possible to run the sheet over an idler pulley at the tail, much smaller than the tail pulley, thus making possible a short drop of the discharged material. This has been indicated in the drawing. Wear sheets are obtainable for operating on hot materials at temperatures up to 500 deg. F. For such service the sheet is manufactured with wire inserted asbestos cloth and makes use of a compound which is especially adapted to withstand high temperatures. The compound is said not to overcure due to the excess temperature.

Among the advantages which are claimed for the Duplex system are savings in conveying costs, ease of replacement, less breakage of material, possibility of troughing at any angle up to 45 deg. without injury to the wear sheet, use of a narrower power belt than would be necessary to carry the load, increased life of the power transmission belt, and a saving in conveyor cost, through the possible use of smaller sizes of head and tail pulleys.

Humphrey Unit Heater

Hitherto, all of the unit heaters for industrial purposes which have come to the attention of the editors have been of the steam-heated or electrical types. Now there is announced by the General Gas Light Company of Kalamazoo, Mich., a new gas-fired unit heater



New Gas-Fired Industrial Heating Unit

known as the "Humphrey Industrial Unit." This has a number of interesting features, not the least of which are the automatic devices that are said to make attendance practically unnecessary.

The heater has a capacity approximately equivalent to 400 sq.ft. of ordinary steam radiation and is equipped with a fan delivering 1,800 cu.ft. of heated air per minute. The heater is arranged for suspension from the ceiling. The heating element consists of a bank of special Ni-Chrome gas burners above which is a battery of brass tube radiators so arranged that heat from the burner is equally distributed up through the tubes, while the combustion products are carried away by a perforated cap flue or by a ceiling flue if desired. A fan, driven by a ⅛-hp. motor is mounted behind the tubes. The fan not only drives air across the heated tubes but supplies combustion air under pressure to the burner box. Heat control is maintained by a thermostat which is arranged to actuate the motor. The motor is in turn equipped with a governor which turns the gas on and off as required to maintain an even temperature. Pilot lights on either side of the burner control a simple thermostatic switch that automatically prevents the motor from operating in case the pilots are extinguished and keeps the motor and gas supply shut off until the pilots are relighted.

Advantages claimed for the new unit include low maintenance, practically no attention and the lack of necessity for the generation of steam for heating purposes. The heater is consequently suggested especially for plants where steam is not otherwise required.

Positive Displacement Meter

A new double-impeller, positive displacement gas meter has been developed and placed upon the market by P. H. & F. M. Roots Company, Connersville, Ind. Its principle of operation is essentially the same as that of this company's gas pumps. The unit consists of two rotors mounted on parallel shafts and rotating with close clearance within a casing. Gears mounted on the shaft maintain the rotors in proper timing.

Gas entering at one side of the meter causes the rotors to revolve, which revolution is integrated by means of a mechanism calibrated in cubic feet of gas flow. The rotors are mounted on anti-friction bearings and timed with gears at one end of the shaft only. The new meter, known as model SA, is made in capacities ranging from 100 to 1,000,000 cu.ft. per hour. Meters are made in two styles for pressures up to 10 lb. for the light duty, and 100 lb. per sq.in. for the heavy duty models. Special instruments for recording such quantities as time, pressure, temperature and volume in various combinations are supplied if desired.

The Roots Company also calls attention to the fact that its line of blowers has now been modified to permit the use of anti-friction roller and ball bearings

High-Speed Electrode

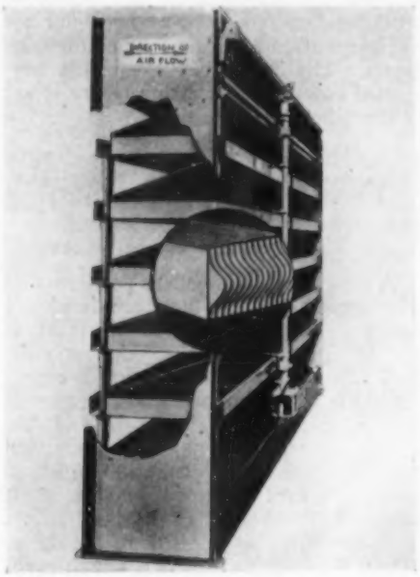
A new electrode for high-speed welding, known as the "Fleet-weld," is the most recent product announced by the Lincoln Electric Co., Cleveland. The new welding rod is said to permit welding speeds of two to three times that formerly possible through its ability to

Comparison Between Metal Deposited From an Ordinary Rod at the Left, and the New Electrode at the Right

give a dense, non-porous deposit of metal which has at the same time a smooth bead, at high current densities. Greater ductility of the bead as well as deeper penetration are also said to be advantages.

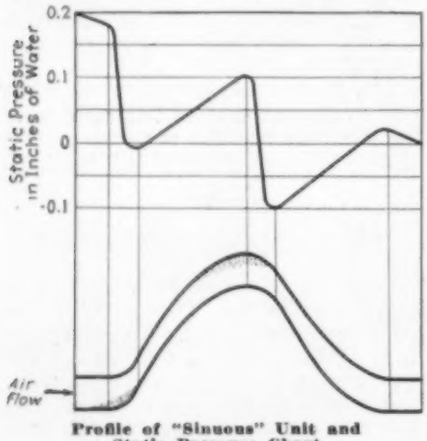
Low-Resistance Air Filter

A radically new type of filter cell, which may be applied either to horizontal or vertical air filters, has recently been placed upon the market by Midwest Air Filters, Inc., Bradford, Pa. The



Assembly of Horizontal "Sinuous" Units

principal feature of the new filter cell lies in the design of the baffle plates shown in cross-section in the accompanying sketch. In the average filter of the type which employs centrifugal action to cause the dust to impinge upon oiled surfaces, air flow is uncontrolled, and eddy currents are set up, resulting in high power consumption. The new design, making use of the Venturi principle, regains a portion of the pressure drop, as is shown in the static pressure diagram. At the same time, the air is twice accelerated, twice retarded, and twice caused to change its direction rapidly, thus throwing out the dust particles.



Profile of "Sinuous" Unit and Static Pressure Chart

In order to trap the particles of dust which impinge upon the surfaces, the latter are flooded at intervals with a viscous oil, known as "Viscosine." When next flooded, the dirty oil is carried away to a settling tank, where the dust is removed as a sludge by natural settling.

Two models of this air filter are made. One, the horizontal filter, shown in the illustration, is provided in cells 29 in. x 19⅝ in. x 3⅛ in., with a capacity of 3,000-3,500 c.f.m. of air. These cells may be combined to furnish any capacity up to 240,000 c.f.m. The maximum resistance of this filter is 0.34 in. of water. The second model is a vertical filter in which the filter cells measure 20 in. x 20 in. x 2¾ in., with a maximum air resistance of 0.20 in. of water for the cell. The capacity in this case is 2,000 c.f.m. and units may be supplied in various combinations up to a total capacity of 50,000 c.f.m. The guaranteed efficiency of dust removal for each type of assembly is from 96 to 99 per cent.

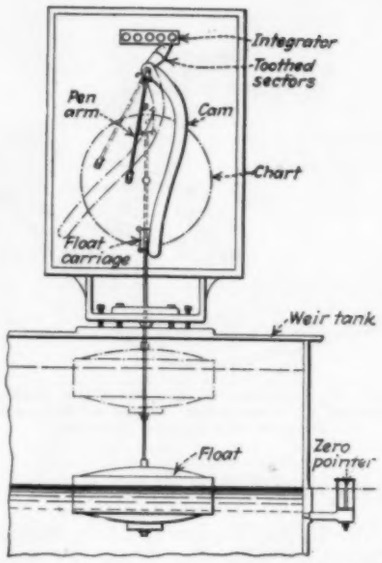
City-Gas Drier

It is well known that water in city gas is conducive to such troubles as loss of pressure, deposits in mains and corrosion. To combat this difficulty the West Gas Improvement Company, 441 Lexington Ave., New York, N. Y., has developed what is known as the "Dry-gas" Process. This makes it possible to dehydrate gas with the addition of only a small amount of equipment, the apparatus employed being largely already in use in all gas works.

In operation, the system consists of an absorber over which a calcium chloride solution is pumped counter to the gas flow. The solution is constantly re-circulated while a small quantity is bypassed through an evaporator to maintain the proper strength. A cooler maintains a low temperature in the brine going to the absorber. It is claimed that the total cost of operation, including all charges, does not exceed one-half cent per thousand cubic feet of gas treated.

Improved Weir-Meter Recorder

A novel piece of mechanism developed by the Cochrane Corporation, Philadelphia, has been incorporated in this company's improved V-notch recorder. The flow of liquids is measured by determining the head of liquid flowing through a V-notch weir, and it is obvious that some form of differential float, or a cam motion must be used if the recorded flow is to give straight-line characteristics at all parts of the scale. The new system, which is said to eliminate the backlash inherent in most types of cams, consists of a pendulum-like cam of simple design suspended from and pivoted on the shaft carrying the pen arm. A counterweight attached to the cam keeps the latter bearing upon a roller fastened



Float, Cam and Pen Mechanism of the Improved Cochrane V-Notch Recorder

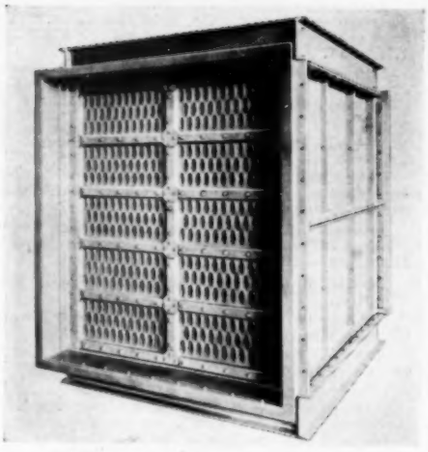
to a carriage which moves vertically. The carriage is positively located by the position of the float, and this in turn locates the cam and the pen.

As the flow varies as the 5/2 power of the head, the upper ranges of a graph of head vs. flow are very steep and head variation at large flow is very small. The new cam surmounts this difficulty through its design, shown in the sketch, which imparts greatest motion to the pen as the float approaches the position of maximum delivery.

The recorder also includes an integrator and an instantaneous-flow pointer which indicates on a large scale. The latter is connected to the pen arm shaft through a pair of links. The former is driven from the same clock mechanism which operates the chart and is controlled according to the instantaneous flow rate through a pair of toothed sectors which transmit the motion of the main cam to a secondary cam within the integrator. The clock mechanism, at equal short intervals, advances a clutch within the integrator, whose motion is passed on to the integrator gear train to an amount determined by the position of the secondary cam and proportional to the location of the float and the head of liquid flowing over the weir. It will be seen that the counting train is thus advanced for each interval of time by an amount proportional to the instantaneous rate of flow and that the results for any longer period of time will be the totallized or integrated flow.

Oval Tube Air Heaters

The principle of the oval tube radiator, described in *Chem. & Met.* for July, 1928, has been extended by its makers, the Shaw-Perkins Manufacturing Company, Pittsburgh, Pa., to an application in heat exchangers. As explained in connection with the radiators, the oval tube design tends toward stream-line gas flow past the tubes and keeps draft losses low. The design is also said to permit especially good heat transfer.



Oval Tube Heat Exchanger Assembly

As a basis for the new exchanger, a number of the tubes are mounted together into rectangular headers to form a unit block of tubes which may then be assembled together in any desired number or relation in a casing to form the complete heat exchanger. Tube units may be connected in series or in parallel to give any number of passes of the air or gas to be heated, while simultaneously, any desired capacity may be attained.

The heating elements are available in four header sizes of ten different tube lengths each, thus giving 40 standard sizes of heating elements and providing for an infinite range of heater dimensions and capacities. Heaters may be used for recovering waste heat from flue gases for combustion air or for heating air for any heating or drying process.

Aluminum Solder

A new aluminum solder known as "Soldalume" has been announced by the Aluminum Solder Corporation of America, 730 Fifth Ave., New York, N. Y. The solder consists of a white powder which is melted at a temperature of 350 to 400 deg. F., by heat applied to the metal at a point adjacent to the joint to be made. It is said that a temperature of 800 deg. F., is required to destroy the joint. Tests are reported to have given a tensile strength of 12,000 pounds per sq.in. for aluminum-to-aluminum butt joints and 30,000 pounds for duralumin butt joints.

New Combustion Meter

Announcement is made by the Hayes Corporation, Michigan City, Ind., of its new model C combustion meter for CO_2 and draft recording. This instrument may also include the recording of flue gas temperature or the latter may be substituted for the draft record. The instrument employs the same Orsat principle of operation that was used in model B, recently described in *Chem. & Met.* The changes are largely in the recording end. Suspended pens, a new type of case and a 10-in. chart are features of the new model.

Manufacturers' Latest Publications

Air Conditioning. Niagara Blower Company, 95 Liberty St., New York, N. Y.—Bulletin No. 6—Describes the new Niagara air conditioner.

Apparatus. Leeds & Northrup Company, 4901 Stenton Ave., Philadelphia, Pa.—Circular 7654a—Shows a pH indicator for industrial control purposes.

Apparatus. The Ruth Company, Denver, Colo.—1929 bulletin describing laboratory rod mills and flotation equipment.

Blowers. Connersville Blower Company, Connersville, Ind.—Bulletin No. 121—Describes "Victor" rotary blowers for pressure or suction service.

Chemicals. Dow Chemical Company, Midland, Michigan—New 102 page catalog of Dow products, beautifully bound and illustrated with many plant pictures, reproduced from photographs and oil paintings. Lists and describes in some detail the appearance, properties, specifications, uses, shipping classification and packing of some 133 Dow products including pharmaceuticals, industrial chemicals, Dowflake calcium chloride, miscellaneous chemicals, metal and alloys, dyes and insecticides.

Chemicals. Glyco Products Company, Inc., Bush Terminal Building No. 5, Brooklyn, New York—A series of sheets describing various "Glycopon" products consisting of substitutes for various organic materials and emulsifying agents.

Chemicals. Niagara Alkali Company, Niagara Falls, N. Y.—Leather bound handbook on caustic soda and potash. Covers properties, packaging, analysis, handling, and storage of solid and liquid caustics.

Compressors. Ingersoll-Rand Company, 11 Broadway, New York, N. Y.—Bulletin No. 3149—Completely descriptive of the new type XG gas-engine-driven compressor for service in compressing air or gas.

Conveyors. Audubon Wire Cloth Company, Audubon, N. J.—Booklet No. 35—Folder concerning flexible, spiral-woven wire fabrics for conveyor belts, made in all metals.

Electrical Equipment. Colt's Patent Fire Arms Manufacturing Co., Hartford, Conn.—Bulletin No. S-22A—Concerns "Noark Quadbreak" polyphase switches for meter and service entrance.

Electrical Equipment. Crouse-Hinds Company, Syracuse, N. Y.—Publications as follows: Bulletin G-9, "Groundulets Make Electrical Circuits Safe," bulletin 2125, flexible fixture hangers; bulletin 2126, threadless Condulets, connectors and couplings.

Electrical Equipment. The Elliott Company, Jeannette, Pa.—Bulletin No. L-1, induction motors; Bulletin No. J-1, engine-type commutating pole generators, type K.

Electrical equipment. General Electric Company, Schenectady, New York—Publications as follows: GEA-408A, G. E. electrical heating equipment for industrial ovens; GEA-823B, Atomic Hydrogen Arc Welding Equipment; GEA-874C, type WD-200A Arc Welders; GEA-876B, type WD-400A Arc Welders; GEA-913A, Automatic Time Switches; GEA-941A Reciprocating Air Compressors; GEA-985, G. E. Elevator Control; GEA-1006A Automatic Supervisory Equipment; GEA-1022A, Automatic Arc Welder For Steel Rail Ties; GEA-1031A, Type AW Resistor Arc Welders; GEA-1042, Type H Distribution Transformers.

Electrical Equipment. Sangamo Electric Company, Springfield, Ill.—Bulletin No. 76—Describes a meter for electroplating control.

Electrical Equipment. Wagner Electric Corp., St. Louis, Mo.—Publications as follows: Bulletin 138, fourth edition, 20 pages, manual on testing single and polyphase motors and transformers; Bulletin 158, describes small vertical motors; Bulletin 160, 52 pages, concerns Wagner distribution transformers, giving descriptions and data.

Electric Furnaces. Drying Systems, Inc., 11 South Desplaines St., Chicago, Ill.—Bulletin No. 1—Describes various sizes of electric smelting furnaces for temperatures up to 3,000 deg. C. and capacities to 218 cubic inches.

Equipment. Industrial Welded Products Company, 1054 Grand Central Terminal Building, New York, N. Y.—Bulletin showing facilities and a variety of the products of this company, welded in chrome iron and nickel chrome alloys.

Equipment. Paper & Textile Machinery Company, Sandusky, Ohio—Bulletin No. 508—"Fluid Compressed Products," describes the field, facilities and activities of this company in producing cast cylindrical equipment for paper and textile manufacture in various ferrous and non-ferrous metals.

Equipment. Robinson Manufacturing Company, Muncie, Pa.—Folder No. 206—Concerns sifters, bolters, disintegration equipment, mixers, handling and storage equipment.

Equipment. A. O. Smith Corporation, Milwaukee, Wis.—Bulletin No. 507—Describes the properties of Smithwelding and the manufacture and testing of Smithwelded equipment.

Fire protection. Wirt & Knox Manufacturing Company, York St. and Sedgely Ave., Philadelphia, Pa.—Catalog A28—Catalog of many types of industrial fire fighting equipment.

Fuels. Combustion Engineering Company, 200 Madison Ave., New York, N. Y.—Two publications: a reprint of a paper entitled "Lignite As a Commercial Fuel"; also a reprint entitled "Powdered Fuel in Metallurgical Work."

Instruments. Esterline-Angus Company, Box 596, Indianapolis, Indiana—Folder No. 53—"Measuring Labor Efforts Electrically," describing the use of graphic wattmeters.

Instruments. O. Zernickow Company, 15 Park Row, New York, N. Y.—Describes O-Z improved hand tachometers.

Material Handling. Cleveland Crane & Engineering Company, Wickliffe, Ohio—Forms TR-517 and 603—respectively, on the use of tramrails in the rubber plant and a folder on general use of tramrails.

Metals and Alloys. International Nickel Company, 67 Wall St., New York, N. Y.—Folder giving 12 foundry mixtures for nickel cast iron. Also Nickel Steel Bulletin No. 13 on "Torsion, Impact and Other Mechanical Properties of S.A.E. 3130 Nickel-Chromium Steel."

Power Transmission. Morse Chain Company, Ithaca, N. Y.—Bulletin No. 35—Covers stock sprockets and chains from 1 to 25 hp.

Proportioning Pumps. Hills-McCanna Company, 2549 Nelson St., Chicago, Ill.—Booklet 4088—Describing a complete line of proportioning pumps.

Protective Coatings. The Glidden Company, Cleveland, Ohio—Brochure giving annual report and word-and-picture description of Glidden properties.

Pumps. Lawrence Pump & Engine Company, Lawrence, Mass.—Bulletins D-20, 21, 25, 28 and 30—Describing Lawrence "Vortex" centrifugal pumps; respectively, single stage double suction, single suction, sand pumps, and stock pumps for pulp.

Pumps. Pennsylvania Pump and Compressor Company, Easton, Pa.—Bulletin No. 213—Describes a new centrifugal, pumping outfit powered with an 8 hp. Le Roi engine.

Refractories. General Refractories Company, 106 South 60th St., Philadelphia, Pa.—Folders describing "Biasbrix" and "Standard" Silica bonding cement.

Regulators. Fulton Sylphon Company, Knoxville, Tenn.—Bulletin No. B-100—Describes the complete line of Sylphon regulators for pressure and vacuum.

Regulators. Northern Equipment Company, Erie, Pa.—Forms 101 and 103—Covering respectively Copes type DS pump governors and type SS differential water pressure regulating valves.

Screens. Manganese Steel Forge Company, Philadelphia, Pa.—Bulletin No. 120—"Saving and Making Money With Rol-Man Screens," 48 page bulletin describing the use of manganese steel screens with all types of screening equipment.

Speed Reducers. The Falk Corporation, Milwaukee, Wis.—Bulletin No. 190—A 68 page catalog showing engineering data and installation photographs of herringbone gear speed reducers.

Speed Regulators. Reeves Pulley Company, Columbus, Indiana—A folder on modernization of equipment through use of the new Reeves variable speed drive.

Steam Generation. Erie City Iron Works, Erie, Pa.—Bulletins SB-6 and 7—Describing respectively powdered coal fired R.T. boilers and the Seymour-Carbofrax furnace.

Steam Generation. Yarnall-Waring Company, Chestnut Hill, Philadelphia, Pa.—Bulletin WC-1801, also a celluloid working model, both describing the operation of the floatless "Hi-LO" alarm water column and inclined water gage.

Strainers. The Elliott Company, Jeannette, Pa.—Bulletin AA—Describes twin strainers for oil lines.

Traps. Warren Webster Company, Camden, N. J.—Describes Webster Series 78 thermostatic traps, for pressures of 10 to 100 lb.

Ventilation. Peerless Electric Company, Warren, Ohio—Folder describing various types of small exhaust fans.

Water Cooling. The Marley Company, Kansas City, Mo.—"Marley Spray Cooling Towers," a catalog describing Marley spray cooling towers in detail.

PATENTS ISSUED
Jan. 1 to Jan. 29, 1929

Paper, Pulp, Glass and Sugar

Mixing Tank. Joseph A. White, Philadelphia, Pa., assignor to Grellet Collins, Philadelphia, Pa.—1,696,994.

Method of Cooking Sulphite Pulp. George H. Tomlinson, Montreal, Quebec, Canada. —1,697,032.

Drawing Sheet Glass. Clarence P. Byrnes, Sewickley, Pa.—1,697,104.

Method and Apparatus for Producing Sheet Glass. Richard D. Humphreys, Mount Kisco, N. Y., assignor to Mississippi Glass Company.—1,697,504.

Process for Making Waterproof Straw Pulpboard. Edward B. Weston, Dayton, Ohio, and William G. Clark, Terre Haute, Ind., assignors to The Terre Haute Paper Company, Terre Haute, Ind.—1,697,702.

Variable-Speed Paper-Machine Drive Train. Harold F. Dunbar, Turners Falls, Mass.—1,698,189.

Method of Regulating Glass Temperatures in Drawing Tanks. Walter G. Koupal, Tarentum, Pa., and Joseph S. Gregorius, Mount Vernon, Ohio, assignors to Pittsburgh Plate Glass Company.—1,698,369.

Method and Apparatus for Digesting Fibrous Material. Thomas L. Dunbar and August F. Richter, Watertown, N. Y., assignors to Chemipulp Process Inc., Watertown, N. Y.—1,699,056.

Process for Treating Sulphite Pulp Waste. John T. Travers, Columbus, Ohio, assignor, by direct and mesne assignments, to The Travers-Lewis Process Corporation, Columbus, Ohio.—1,699,258.

Acid-Sulphite-Pulp Process. Robert B. Wolf, New York, N. Y.—1,699,556.

Glass-Feeding Apparatus. Albert N. Cramer, Toledo, Ohio, assignor to The Owens Bottle Company, Toledo, Ohio.—1,699,563.

Method of Treating Waste Liquor. Erik Ludvig Rinman, Djursholm, Sweden.—1,699,808.

Process of Treating Waste Sulphite Liquor. Guy C. Howard, Seattle, Wash.—1,699,845.

Log-Barking Apparatus. Herbert W. Guettler, Chicago, Ill.—1,700,220.

Method of Making Solid Cast Refractory Articles. Gordon S. Fulcher, Corning, N. Y., assignor to Corning Glass Works, Corning, N. Y.—1,700,288.

Method of and Apparatus for Bleaching Paper Pulp. Johannes Ruths, Djursholm, Sweden, assignor to Ruths Accumulator Aktiebolag, Stockholm, Sweden.—1,700,647.

Rubber, Rayon and Synthetic Plastics

Process for Purifying Phenolformaldehyde Resins. Fritz Seebach, Erkner, near Berlin, Germany, assignor to Bakelite Gesellschaft mit beschrankter Haftung, Berlin, Germany.—1,697,885.

Cellulosic Material and Product Obtained Therefrom. Henry Dreyfus, London, and Clifford Ivan Haney, Spondon, near Derby, England, assignors to Celanese Corporation of America.—1,697,907.

Process of Making Cellulose Aceto Esters Containing Higher Acyl Groups. Hans T. Clarke and Carl J. Malm, Rochester, N. Y., assignors to Eastman Kodak Company, Rochester, N. Y.—1,698,048-9.

Process for Controlling the Vulcanization of Rubber and Similar Materials. Sidney M. Cadwell, Leonia, N. J., assignor to The Naugatuck Chemical Company, Naugatuck, Conn.—1,698,712-15.

Production of Condensation Products of Methylol Compounds of a Urea. Martin Luther, Mannheim, and Claus Heuck, Ludwigshafen-on-the-Rhine, Germany, assignors to I. G. Farbenindustrie Aktiengesellschaft, Frankfort-on-the-Main.—1,699,245.

Method of Preserving Rubber Latex and Product Thereof. John McGavack, Jackson Heights, N. Y., and Roy A. Shive, Wilmington, Del., assignors to The Naugatuck Chemical Company, Naugatuck, Conn. —1,699,368-9.

Apparatus for Measuring and Depositing Plastic Substances. George Donald Wilson, London, England, assignor to Baker Perkins Co., Inc., Saginaw, Mich.—1,699,417.

Process for Manufacturing Artificial Silk and Other Filaments by Applying Electric Current. Kiyohiko Hagiwara, Oji-Machi, Kamikyo-Ku, Kyoto, Japan, assignor to Toshiya Iwasaki, Tokyo, Japan.—1,699,615.

Sulphur Composition and Process of Making Same. Carleton Ellis, Montclair, N. J., assignor to Ellis-Foster Company.—1,699,694.

Phenolic Condensation Products and Processes of Making the Same. Archie J. Weith, Evanston, Ill., assignor to Bakelite Corporation, New York, N. Y.—1,699,727.

Process of Condensation of Mixed Aldehydes. Robert H. Van Schaack, Jr., Evanston, Ill., assignor to Van Schaack Bros. Chemical Works, Inc., Chicago, Ill.—1,700,103.

Method and Apparatus for Refining Reclaimed Rubber. John F. Fisher and Wallace R. Gillam, Phoenixville, Pa., assignors to The Philadelphia Rubber Works Company, Wilmington, Del.—1,700,287.

Cellulose Composition for Esterification and Process of Preparing Same. George A. Richter, Berlin, N. H., assignor to Brown Company, Berlin, N. H.—1,700,595-6.

Petroleum Refining and Products

Continuous Process for the Refining of Oils. Eric Th. Hessle, Lemont, Ill.—1,696,913.

Manufacture of Oxidation Products of Hydrocarbons. Francis J. Carman, New York, N. Y.—1,697,105-6.

Method and Means for Recovering Oil. Bruce M. Cloud, Montpelier, Ind.—1,697,260.

Process of Oxidizing Petroleum Oils. Carleton Ellis, Montclair, N. J., assignor to Ellis-Foster Company.—1,697,262-7.

Pressure Distillation of Hydrocarbon Oils. Francis M. Rogers and Edward J. Shaeffer, Whiting, Ind., assignors to Standard Oil Company, Chicago, Ill.—1,697,573.

Manufacturing of Lubricating Oil. George H. Taber, Jr., Rye, N. Y., assignor to Sinclair Refining Company, New York, N. Y.—1,698,076.

Apparatus for and Method of Treating Oil. Edwin S. Pearce, Indianapolis, Ind.—1,698,273.

Refining Hydrocarbon Oils. Henry J. Broderson, Whiting, Ind., assignor to Standard Oil Company, Whiting, Ind.—1,698,428.

Art of Handling Heavy Oil Residues. Oscar E. Bransky and Francis M. Rogers, Whiting, Ind., assignors to Standard Oil Company, Whiting, Ind.—1,698,471.

Apparatus for Distilling Oil. Henry S. Pettingill, Jr., Bartlesville, Okla., assignor, by mesne assignments, to Empire Refineries, Inc., Tulsa, Okla.—1,698,507.

Process of Refining Oil. Chauncey B. Forward, Urbana, Ohio.—1,698,811.

Process of Separating Paraffinous Constituent from Fluid Hydrocarbons. Erik August Forsberg, Stockholm, Sweden, assignor to Aktiebolaget Separator-Nobel, Stockholm, Sweden.—1,699,286.

Process of Making By-Products from Inactive and Inert Oils or Gases. Charles S. Palmer, Pittsburgh, Pa.—1,699,627.

Lubricant and Method of Making the Same. Joseph Hidy James, Pittsburgh, Pa., assignor to Clarence P. Byrnes, trustee, Sewickley, Pa.—1,700,055-6.

Process of Refining Mineral Oil. Henry Blumenberg, Jr., Los Angeles, Calif.—1,700,347.

Prevention of Evaporation Losses. Harold V. Atwell, Whiting, Ind., assignor to Standard Oil Company, Whiting, Ind.—1,700,362.

Apparatus for Combining Natural Gas and Hydrocarbon Oil for the Production of Gasoline. Lester S. Worthington, Casper, Wyo., assignor to C. L. Thompson, Casper, Wyo.—1,700,556.

Emulsification of Tar, Bitumen, Creosote, Petroleum, Heavy Oils, and the Like. Wilfred Ernest Billinghame, Lee, England.—1,700,581.

Mineral-Oil Vaporizer. Arthur E. Pew, Jr., Bryn Mawr, Pa., assignor to Sun Oil Company, Philadelphia, Pa.—1,700,709.

Coal Processing and Combustion

Coke-Quenching Car. Jarvis P. Pinder, Johnstown, Pa., assignor to Bethlehem Steel Company.—1,697,475.

Process of Making Producer Gas from Coking Coals. Karl Koller, Budapest, Hungary.—1,697,920.

Distilling Carbonaceous Material. Franz Puening, Pittsburgh, Pa.—1,698,240.

Coke Oven. Carl Otto, Essen-Ruhr, Germany.—1,698,272.

Art of Distilling Carbonaceous Materials. Franz Puening, Pittsburgh, Pa.—1,698,345-9.

Coke Oven. William Montgomery Person, Ashland, Ky.—1,698,651.

Process of Treating Bituminous Material. Mark Ray Cone, Sudbrook Park, Md., assignor, by mesne assignments, to The Union Trust Company, Cleveland, Ohio.—1,698,877-8.

Gas-Analysis Apparatus. Richard H. Krueger, Newark, N. J., assignor to Charles Engalhard, Inc., Newark, N. J.—1,698,887.

Gas-Producing Apparatus. Harry F. Smith, Dayton, Ohio, assignor to The Gas Research Company, Dayton, Ohio.—1,699,166.

Fuel and Process of Making the Same. Grant Hammond, New Haven, Conn., assignor to Fuel Development Corporation, Wilmington, Del.—1,699,355.

Process and Apparatus for Making Coke. Franz Puening, Aspinwall, Pa.—1,699,448.

Method of Making Water Pastes of Bituminous Materials. Louis Cleveland Jones, Greenwich, Conn.; Chauncey C. Loomis, Yonkers, N. Y.; and Henry W. Banks, 3d, Noroton, Conn.; said Loomis and said Banks assignors to said Jones.—1,699,536.

Process of Utilizing Carbonaceous Material. Daniel Pyzel, Oakland, Calif., assignor to Simplex Refining Company, San Francisco, Calif.—1,699,989.

Organic Processes

Process for Preparing Fertilizer. Fritz Rothe, Berlin, and Hans Brenek, Porz, near Cologne, Germany, assignors to the Firm: Rhenania Kunheim Verein Chemischer Fabriken A. G., Berlin, Germany.—1,696,975.

Manufacture of Acetic Acid. Henry Dreyfus, London, England.—1,697,109.

Production of Alkyl Resorcinols. Alfred R. L. Dohme, Baltimore, Md., assignor to Sharp & Dohme, Inc., Baltimore, Md.—1,697,168.

Process for Quantitatively Halogenating Perylene and its Derivatives. Alfred Pongratz and Alois Zinke, Graz, Austria, assignors to Felice Bensa, Genoa, Italy.—1,697,137.

Art of Preparing Metallo-Organic Compounds. Charles A. Kraus and Conral C. Callis, Worcester, Mass., assignors to Standard Oil Development Company.—1,697,245.

Esters of Hydrogenated Aromatic Alcohols. Robert Hubbard Van Schaack, Jr., Evanston, Ill., assignor to Van Schaack Bros. Chemical Works, Inc., Chicago, Ill. —1,697,295.

Method for Treating Heavy Vegetable Oils. Harold S. Adams, New Rochelle, N. Y., and Ludwig Meuser, Boundbrook, N. J., assignors to The Naugatuck Chemical Company, Naugatuck, Conn.—1,697,337.

Purification of Crude Carbon Tetrachloride. Wallace B. Van Arsdel, Berlin, and Harold P. Vannah, Gorham, N. H., assignors to Brown Company, Berlin, N. H. —1,697,483.

Method of Producing Glycol Esters of Abietic Acid. Arthur Langmeier, Dover, N. J., assignor to Hercules Powder Company, Wilmington, Del.—1,697,530.

Process for the Production of New Derivatives of the Condensation Products of Aldehydes and Phenols. Hans Bucherer, Charlottenburg, near Berlin, Prussia, Germany.—1,697,713.

Process for the Recovery of Concentrated Acetic Acid. Hermann Suida, Modling, near Vienna, Austria.—1,697,738.

Apparatus for Treatment of Waste Organic Mixtures and the Like. Gustave T. Reich, Sausalito, Calif.—1,698,171.

Artificial Fertilizer. Heinrich Heimann, Dessau, Germany, assignor to I. G. Farbenindustrie Aktiengesellschaft, Frankfort, Germany.—1,698,793.

Rectification of Acetic Acid. Georges Felix Legendre, Paris, France, assignor to the Firm Société des Etablissements Barbet, Paris, France.—1,698,798.

Process for the Production of Glycerin. Karl Lüdecke and Nelly Lüdecke, Berlin-Dahlem, Germany.—1,698,800.

Purification of Phenyl-Ethyl Alcohol. Edgar C. Britton, Midland, Mich., assignor to The Dow Chemical Company, Midland, Mich.—1,698,932.

Process for Obtaining Hydrogenation Gas for Hydrogenating Carbon and Hydrocarbons from Gases Containing Methane and Hydrogen. Friedrich Bergius, Heidelberg, Germany.—1,699,177.

Process and Composition for Purifying Liquids. Arthur B. Ray, Flushing, N. Y., assignor to Carbide and Carbon Chemicals Corporation.—1,699,449.

Explosive. Alexander Cruickshank Scott, Cardiff, Wales, assignor to Mexco Limited, London, England.—1,700,085.

Inorganic Processes

Method and Apparatus for the Manufacture of Varnish. Elmer E. Ware, Detroit, Mich., assignor to Acme White Lead and Color Works, Detroit, Mich.—1,697,213.

Process of Speeding Chemical Reactions. Herman B. Kipper, Muskegon, Mich. *Producing sodium sulphate and hydrochloric acid.*—1,697,390.

Concentration of Sulphur. Edward Hoit Nutter, San Francisco, Calif., and John W. Littleford, Alameda, Calif., assignors to Minerals Separation North American Corporation, New York, N. Y.—1,697,402.

Process for Recovering Barium as Barium Carbonate from Barium Silicates. Camille Deguide, Enghien, France.—1,697,722.

Alkali-Metal Titanate and Method of Making Same. Lonnie W. Ryan, Niagara Falls, N. Y., assignor to Titanium Pigment Company, Inc., New York, N. Y.—1,697,929.

Process for Producing Aluminum Chloride. Claude G. Miner, Berkeley, Calif.—1,698,238.

Production of Metallic Chloride. René de M. Taveau, Elizabeth, and Cyril B. Tygert, Bayonne, N. J., assignors, by mesne assignments, to The Texas Company, New York, N. Y.—1,698,324.

Process of Hydrating Phosphoric Anhydride. Edouard Urbain, Paris, France, assignor to Urbain Corporation.—1,698,484.

Process of Purifying Gases. Joseph G. Dely, Jamaica, N. Y., assignor to Atmospheric Nitrogen Corporation, Solvay, N. Y.—1,698,718.

Process of Exploiting Gases Containing Nitrogen, Hydrogen and Carbon Dioxide. William N. Henderson, Syracuse, N. Y., assignor to Solvay Process Company, Solvay, N. Y.—1,698,722.

Process for the Production of Acid Sodium Pyrophosphate. John N. Carothers and Charles F. Booth, Anniston, Ala., assignors to Federal Phosphorus Company, Birmingham, Ala.—1,699,093.

Process for the Manufacture of Anhydrous Metallic Chlorides. William F. Downs, Chatham, N. J.; Mary Gardner Downs administratrix of said William F. Downs, deceased.—1,699,229.

Apparatus for Refining Raw-Carbon Disulphide. Philipp Siedler, Griesheim-on-the-Main, and Eugen Schulte, Schwanheim-on-the-Main, Germany, assignors to I. G. Farbenindustrie Aktiengesellschaft, Frankfort-on-the-Main, Germany.—1,699,255.

Production of Dicalcium Phosphate and Ammonium Sulphate. Jacob Frederick Carl Hagens and Ludwig Rosenstein, San Francisco, and Wilhelm Hirschkind, Antioch, Calif., assignors to The Barrett Company, New York, N. Y.—1,699,393.

Process for Making Colloidal Adsorption of HCl. Vincent A. Lapenta, Indianapolis, Ind.—1,699,596.

Producing Alkali-Metal Nitrate. Wilhelm Wild and Christoph Beck, Ludwigshafen-on-the-Rhine, Germany, assignors to I. G. Farbenindustrie Aktiengesellschaft, Frankfort-on-the-Main, Germany.—1,699,643-4.

Process for the Manufacture of Arsenic Acid. Fritz Ullmann, Charlottenburg, and Gert Trewendt, Berlin, Germany, assignors to **J. Michael & Co.**, Berlin, Germany.—1,699,823.

Manufacture of Calcium Nitrate. Karl Blumrich, Hochst-on-the-Main, Germany, assignor to I. G. Farbenindustrie Aktiengesellschaft, Frankfort-on-the-Main, Germany.—1,700,116.

Decolorizing Carbon. Edouard Urbain, Paris, France, assignor to Urbain Corporation.—1,700,342.

Water Paint. Alfred P. Goodell, Salem, and Gardner W. Tarr, Everett, Mass.—1,700,404.

Production of Hydrogen Sulphide. Raymond F. Bacon, Bronxville, N. Y.—1,700,578.

Process for Recovering Chromium from Chromiferous Waste Materials. August Treusch, Offenbach-on-the-Main, and Richard Würtenberger, Darmstadt, Germany, assignors to the Firm J. Mayer & Sohn, Offenbach - on - the - Main, Germany.—1,700,657.

Production of Phosphorus Pentoxide and Phosphoric Acid. Gustav Pistor, Hermann Lang, and Robert Suchy, Bitterfeld, Germany, assignors to the Firm I. G. Farbenindustrie Aktiengesellschaft, Frankfort-on-the-Main, Germany.—1,700,708.

Copies of Patents

Complete specifications of any United States patent may be obtained by remitting 10 cents to the Commissioner of Patents, Washington, D. C.

Photostatic copies of foreign patents may be obtained at the same address, prices being given on application.

Chemical Engineering Processes and Equipment

Means for Cleaning Filters. Lewis L. Dollinger, Rochester, N. Y., assignor to Staynew Filter Corporation, Rochester, N. Y.—1,691,514.

Method of Measuring the Rate of Mass Flow and the Temperature of Fluids and Apparatus Therefor. Charles F. Brush, Jr., Cleveland, Ohio, and Richard D. Fay, Nahant, Mass., assignors, by direct and mesne assignments, to the Brush Laboratories Company, Cleveland, Ohio.—1,691,600.

Apparatus for the Softening or Purifying of Water or for Carrying Out Processes Based Upon Exchange Reactions. Robert Hunter Thomson, Kingston-on-Thames, and Harold Sydney Lawrence, Ilford, England, assignors to United Water Softeners Limited, London, England.—1,691,862.

Manufacture of Containers for Compressed Gases. Herman E. Sturcke, Port Orange, Fla.—1,692,521.

Ceramic-Glazing Process. Willis O. Prouty, Hermosa Beach, Calif., assignor, by mesne assignments, to American Encaustic Tiling Company, Ltd., Los Angeles, Calif.—1,693,252.

Filtering Process. Justin F. Wait, New York, N. Y.—1,693,417.

Variable-Capacity Pump. Harold E. Balsiger, Waynesboro, Pa., assignor to Landis Tool Company, Waynesboro, Pa.—1,697,041.

Disintegrating Machine. Bernard Cunniff, New York, and Nixon Lee, Forest Hills, N. Y., assignors to Colloidal Equipment Corporation, New York, N. Y.—1,697,052.

Absorption Refrigerating Apparatus. Carl Hochherz, Augsburg, Germany.—1,697,187.

Electric-Furnace Construction. Gottlieb Keller, Brugg, and Ernst Wirz, Baden, Switzerland, assignors to Aktiengesellschaft Brown, Boveri & Cie., Baden, Switzerland.—1,697,188.

Measurement and Regulation of Flow of Steam or Other Fluid. Grant Campbell, Short Hills, N. J., assignor to Campbell Engineering Company, Short Hills, N. J.—1,697,344.

Combined Grizzly and Ball Mill. Arthur F. Levitt, Los Angeles, Calif.—1,697,531.

Drying Method and Apparatus. Clarence L. Colbert, Elizabeth, N. J., assignor to Fiske & Company, Inc., Boston, Mass.—1,697,556.

Drier. Alpheus O. Hurxthal, Philadelphia, Pa., assignor to Proctor & Schwartz, Incorporated, Philadelphia, Pa.—1,697,651.

Apparatus for Pulverizing. Wilfred Rothery Wood, London, England, assignor to International Combustion Engineering Corporation, New York, N. Y.—1,697,704.

Separating Liquids and Means Therefor. Frank Pink, Portsmouth, England.—1,698,002.

Apparatus for Separating Liquids of Different Specific Gravity. Frank Pink, Portsmouth, England.—1,698,067.

Pulverizing Machine. Paul S. Knitel, Jersey City, N. J.—1,698,268.

Process of Effecting Reaction Between Liquids Tending to Form Tight Emulsions. Ford H. McBerty, Poughkeepsie, N. Y., assignor to The De Laval Separator Company, New York, N. Y.—1,698,270.

Device for Utilizing the Heat Radiated from Kilns. Fritz Luther, Dessau, Germany, assignor to the Firm G. Polysius, Dessau, Germany.—1,698,313.

Apparatus for the Production of Dispersions of Solids in Liquids. William Henry Whatmough, London, England, assignor to Standard Products Corporation, New York N. Y.—1,698,354.

Air Separator. John W. Dreisbach, Golconda, Ill.—1,698,361.

Method of and Apparatus for Gasification. Philip d'H. Dressler, Cleveland, Ohio, assignor to American Dressler Tunnel Kilns, Inc., New York, N. Y.—1,698,493.

Pump for Corrosive Liquids. George Prescott Fuller, La Salle, N. Y., assignor, by mesne assignments, to Edward Michael, Frank R. Collins, and Frank J. Tone, constituting Bondholders' Protective Committee of Electrolytic Holding Company, Inc.—1,698,495.

Drying Apparatus. Thomas A. Hill, Manhattan Beach, N. Y.—1,698,545.

Attrition Mill. James G. Bryant, Port Huron, Mich.—1,698,838.

Method of and Apparatus for Producing Refrigeration and Chemical Compounds Useful Therein. Frederick G. Keyes, Cambridge, Mass., assignor, by mesne assignments, to National Refrigerating Company, a Corporation of Massachusetts.—1,698,847.

Method and Apparatus for Effecting Chemical Reactions. Grinnell Jones, Cambridge, Mass.—1,699,070.

Art of Increasing the Adsorptive Power of Charcoal. Harvey B. Lemon, Chicago, Ill.—1,699,243.

Process of and Material for Treating Sewage and Industrial Waste. John T. Travers, Columbus, Ohio, assignor, by direct and mesne assignments, to The Travers-Lewis Process Corporation, Columbus, Ohio.—1,699,257.

Process and Apparatus for the Dry Separation of Masses of Materials. Henry Moore Sutton, Walter Livingston Steele and Edwin Goodwin Steele, Dallas, Tex.—1,699,382.

Centrifugal Separator. William C. Laughlin, Glendale, Calif., assignor to Laughlin Filter Corporation, New York, N. Y.—1,699,471.

Method and Apparatus for Grading Material. Damon D. Dunkin, Guion, Ark.—1,699,522.

Process for Making Varnish. Bailey F. Williamson and Walter H. Beisler, Gainesville, Fla.—1,699,646.

Material Conveyer for Furnaces. Frank T. Cope, Salem, Ohio, assignor to The Electric Furnace Company, Salem, Ohio.—1,699,955.

Reversible Flow Meter. Frederick N. Connet, Providence, R. I., assignor to Builders Iron Foundry, Providence, R. I.—1,700,027.

Production of Portland Cement. Harvey Randolph Durbin, Larchmont, N. Y., assignor to International Cement Corporation, New York, N. Y.—1,700,032-3.

Counterflow Condenser. Henry D. Hughes, Dallas, Tex.—1,700,498.

Method for Purifying Gases. Walter H. Fulweiler, Wallingford, Pa., assignor to The U. G. I. Contracting Company, Philadelphia, Pa.—1,700,698.

Method for Clearing and Purifying Water for Steam Boilers of All Kinds. Julius Ostertag, Stuttgart, Germany.—1,700,714-6.

NEWS *of the Industry*

Unfair Practices Barred by Fertilizer Trade

DELEGATES representing fully 75 cent of the fertilizer industry agreed in the adoption of a series of resolutions barring unfair trade practices in a meeting held Jan. 29 at the National Chamber of Comerce building in Washington. In his opening statement, Judge Edgar A. McCullough, chairman of the Federal Trade Commission, who presided, welcomed the group into the trade practice conference system whereby industries have been able to make their own rules of conduct with the Commission to give guidance and enforcement. Charles J. Brand, executive secretary of the National Fertilizer Association which sponsored the meeting, stressed the need of eliminating cut-throat competition and sharp practices which have come about as a result of overproduction.

The resolutions, which hint at the type of trouble to be dealt with, define the following as unfair trade practices:

Sale below cost with the intent of disturbing markets, injuring competitors, or lessening competition, true cost to be determined by sound accounting methods.

Granting of secret rebates in any form by practices such as:

a. Billing of goods at prices which do not reflect actual return.

b. Providing truck service without adequate charge.

c. Selling chemicals and materials at reduced prices to induce the purchase of mixed fertilizer or other fertilizer materials.

d. Failure to enforce in good faith the terms of contracts previously made, for example:

1. Selling on terms that require the payment of sight draft on presentation of bill of lading (S.D.B.L.) and then waiving the obligation to pay cash before delivery thus deferring payment.

2. Selling or delivering goods on time, consignment, or open bill of lading terms of S.D.B.L. price or waiving earned interest.

e. Furnishing special containers, formulas, or ingredients without adequate charge as an inducement to sales.

f. Making special allowances to buyers or consignees under the guise of advertising expense or giving any other form of gratuity.

g. Adopting selling methods that promote secret rebates and concessions such as:

1. Employing a buyer or consignee or anyone connected with the purpose of influencing business.

2. Carrying on books as delinquent balances due by solvent customer with no intention of collecting.

h. Enabling the customer to obtain fertilizer apparently on cash terms but in fact on credit, as for example:

A transaction covered by a sight draft and bill of lading under which the purchaser appears as honoring documents to be paid on presentation with his own funds when in fact the cash involved was obtained upon a negotiable instrument endorsed by the manufacturer; or a transaction whereby the manufacturer, although not endorsing the obligation, renders himself responsible for payment if the customer should fail to meet his obligation to the bank at maturity.

i. "Retroactive settlement" — refunding or rebating to the customer any part of the purchase price on account of goods accepted or settled for by the customer under terms of the contract.

Inasmuch as several of these resolutions have been passed by other industries and accepted by the Commission as "Group One Rules," infractions of which are illegal per se, no serious obstacle is foreseen to prevent their approval. Judge McCulloch reiterated the Commission's intention of proceeding against clandestine violations as bad faith.

Barium Chloride Hearing for March 5

The Tariff Commission has set March 5 as a date to hold public hearings in the pending investigation covering the costs of producing foreign and domestic barium chloride. The hearings to be held on March 5 are not to be confused with those now in progress before the House Ways and Means Committee. The hearings to be held by the Commission represent another step in the course of the investigation to ascertain what it costs to produce barium chloride in this country and abroad.

Anthracite Producers Adopt Research Program

PRODUCERS of anthracite coal have decided to adopt a research program. Daniel T. Pierce, vice-chairman of the Anthracite Operator Conference recently stated that officials of the mining companies were following the recommendations made by engineers including Dr. S. W. Parr, of the University of Illinois; Dr. A. C. Fieldner, chief chemist of the Bureau of Mines; Dr. R. C. Richards, president of Lehigh University, and Henry Kreisinger, research director of the Combustion Engineering Corporation.

The services of Dr. Horace C. Porter, chemical engineer of Philadelphia, have been engaged to guide the pure scientific research program. He will give particular attention to the problem of working towards a more advantageous utilization of the fine sizes and a better financial return therefrom.

R. V. Frost and the Frost Laboratories of Norristown, Pa., have been engaged to conduct the mechanical research and development work. They will determine whether it is practical to mechanically burn larger sizes of anthracite than buckwheat. Mr. Frost will also make a study of the ash removal problem which is now serious.

Chemical Industries Dinner Committee Named

ANNOUNCEMENT has been made by Ralph E. Dorland, of Dow Chemical Co., president of the Salesmen's Association of the American Chemical Industry, of the following appointments to the committee which will have charge of the twelfth annual chemical show week dinner of the chemical industries: Dr. F. P. Summers, Noil Chemical & Color Works, chairman; E. A. Orem. E. I. du Pont de Nemours & Co., speakers; Williams Haynes, Chemical Markets, invitations; Grant A. Dorland. MacNair-Dorland Co., publicity; Victor E. Williams, Monsanto Chemical Works, music and menu; F. A. Koch. Dow Chemical Co., tickets and seating list; and Charles F. Roth, Chemical Industries Exposition, manager. These men expect to get together in the very near future to complete plans for the dinner, which is to be held May 9. Announcements regarding the place, speakers, etc., will be made later on.

Compressed Gas Industry Holds Convention

THE Compressed Gas Manufacturers Association held its annual meeting in New York City January 21, at which time a well attended convention considered a group of technical papers, approximately 20 important committee reports, and transacted routine business, including election of officers. Reports of the secretary and treasurer indicate growth in the membership and an improvement in financial status. For the coming year the executives of the association will be: president, H. M. Hooker, Hooker Electrochemical Company; vice-president, E. C. Turner, Compressed Carbonic Sales Company, and H. W. Cole, General Carbonic Company; Franklin R. Fetherston continues as secretary-treasurer, in charge of the association offices in New York City.

Numerous general committee reports demonstrated the effective work which has been done by the organization during the year. Among the accomplishments reported were several dealing with traffic, safety, container construction, and management problems. The insurance committee has been active in its efforts to secure lower insurance rates on the basis of the very favorable experience which the industry is now reporting. The insurance committee also reported the development of a new form of credit insurance and a suggestion that insurance could be provided guaranteeing return of empty cylinders from customers.

Problems of taxation were considered by the depreciation committee, which has been in active co-operation with the Bureau of Internal Revenue developing new regulations for computing depreciation for tax returns.

Co-operation with the Interstate Commerce Commission and the Bureau of Explosives has resulted in the simplification of many of the rules which control the handling of compressed gases. The handling of stray cylinders has also been developed to the point that all railroads now report such cylinders found on their systems to the headquarters of the association. During the year the transportation committee has also been confronted with many serious proposals affecting freight rates, both on gases and on returned empty cylinders. Through the efforts of the association immediate application of the increased rates has been postponed and further investigation by the Interstate Commerce Commission is in progress.

One of the principal technical problems of the industry is the construction and testing of cylinders for use with high-pressure gases. The cylinder manufacturers committee reports that during the past year they have investigated the feasibility of constructing low-pressure cylinders by welding of the longitudinal seams.

The wide-spread development of mechanical refrigeration has resulted in much work on this subject by the committees considering anhydrous ammonia, sulphur dioxide, carbon dioxide, and hydrocarbon gases. Restrictions on the returning of refrigerants to gas manufacturers' cylinders after use in refrigerating machines have been considered. Proposals have been made to prevent this practice, except under conditions which will insure against over-filling of cylinders.

Mr. and Mrs. Garvan Granted A.I.C. Medal

THE presentation of the medal of the American Institute of Chemists for noteworthy and outstanding service to the science of chemistry and the profession of chemistry in America to Mr. and Mrs. Francis T. Garvan will be made at the meeting of the Institute in the Engineering Auditorium, 29 West 39th Street, New York City, Saturday, May 4, 1929.

The speakers on that occasion will be Hon. John W. Davis, representing the legal profession; Dr. John J. Abel of Johns Hopkins, representing the medical profession, and Dr. John H. Finley, representing the general public. Dr. Charles H. Herty will preside and Dr. Finley will make the presentation. Mr. and Mrs. Garvan will respond.

Higher Duty for Molasses Meets Opposition.

THE National Paint, Oil and Varish Association, through H. S. Chatfield, chairman of its Industrial Alcohol Committee, has filed a brief with the Ways and Means Committee opposing any increase in tariff on blackstrap molasses "not imported to be commercially used for the extraction of sugar or for human consumption." Mr. Chatfield says that such product is the principal source of industrial alcohol; that it is a residue (formerly a waste by-product) of cane sugar manufacture; and that the supply of it from domestic sources is insignificant. In his brief he sets forth innumerable industries which would be seriously affected by the high rates proposed, including the motor trade which he states uses approximately 50,000,000 gal. per annum of denatured alcohol for automobile radiator non-freezing solutions. He points out that the increase in blackstrap molasses tariff demanded by agricultural interests seeking to force a substitution of corn in the manufacture of industrial alcohol would represent an increase of from 2,400 to 3,000 per cent over the present rates and would be reflected in an increase in the present price of industrial alcohol of from 10c. to 12½c. a gal. representing the greater cost of raw material alone. He called attention to the fact that European nations are so concerned with providing an ample supply of industrial alcohol at reasonable prices to their chemical industries that England, as an illustration, grants an allowance of 10c. for every gallon of denatured alcohol used for manufacturing purposes.

Canadian Paper Makers Open Research Institute

THE sixteenth annual meeting of the Canadian Pulp and Paper Association was held in Montreal on January 22 to 25 and is particularly noteworthy because of one outstanding event, namely, the opening and dedication of the Research Institute on the campus of McGill University. This beautiful building is now the home of the Canadian Pulp and Paper Association, the Forest Products Laboratories of Canada and the Cellulose Chemistry Division of McGill University. More than one hundred thousand dollars was appropriated this year by the Association for the operation and maintenance of the Institute. Much credit is due to Col. C. H. L. Jones, the president of the Association, for the initiation and realization of the Institute. The upper floors of the building are used as research laboratories and administrative offices and the basement houses a well-equipped pulp and paper mill, suitable for carrying on semi-plant scale operations. E. Parke Cameron chief of the pulp and paper division of the Laboratories, will direct the activities of the mill.

Preceding the regular meeting of the Association, a symposium on research was conducted by Prof. Harold Hibbert of McGill University. Warren K. Lewis outlined the work of the M.I.T. School of Chemical Engineering Practice and cautioned the McGill faculty not to specialize too highly in any one industry as it might be inclined to do, because of the importance of the cellulose industries to Canada.

IN THE meetings of the Technical Section of the C. P. & P. A. an announcement was made concerning the publication of a Bibliography of Pulp and Paper Making, for which the industry has been long waiting. H. J. Bunke, chief engineer of the Abitibi Power and Paper Company, accepted as chairman of the Technical Section the responsibility of overseeing the activities of the Research Institute.

Among the papers presented that were of interest and were enthusiastically discussed were the following: "Review of the Sulphite Process," by Dr. Emil Heuser; "The Hot Acid Accumulator," by A. D. Merrill, and "Air Systems for the Machine Room," by J. J. Higgins.

Under the direction of Dr. Hibbert there are in process several investigations relating to fundamental research problems in cellulose chemistry. Progress reports on some of these investigations were made. These deal largely with inquiries into the chemical nature of cellulose.

In the elections that were held Col. C. H. L. Jones of the Mersey River Paper Company of Nova Scotia was re-elected president of the Canadian Pulp and Paper Association, and R. A. McInnis, general manager of the Anglo-Canadian Pulp and Paper Company, was elected chairman of the Technical Section.

Tariff Hearings Bring Many Requests For Changes in Duty

Chemical Interests Are Heard on Both Sides of the Question

STARTING the tariff revision hearings, Schedule 1 on chemicals, oils, and paints ran through Jan. 7, 8 and 9. The opening statement was made by Salmon W. Wilder, chairman of the Executive Committee of the Manufacturing Chemists Association. Mr. Wilder sketched the progress of the chemical industry in this country and pointed out the inroads that are being made by foreign countries, principally Germany, due to low wage scales and standards of living. As a protective measure he urged that the rate of 25 per cent ad valorem assigned in the chemical basket clause to all chemicals not otherwise especially provided for be raised to 40 per cent. He indorsed the principle of compensatory duties on manufactured products the raw materials of which are subjected to duty increases. Touching upon the dyestuffs paragraphs, Mr. Wilder recommended that the American valuation basis be continued. As symbolic of the progress made by the industry, the brief submitted to the committee was printed on cornstalk paper.

Speaking for the producers, Dr. E. H. Kilheffer, a representative of the Synthetic Organic Chemical Manufacturers Association and the Newport Chemical Works, named the specific requests of the industry. It was recommended that the ad valorem duty on all synthetic dyestuffs be increased from 45 to 60 per cent as was done during the two years following the passage of the present tariff act in 1922.

H. A. Metz spoke for the General Dyestuffs Corporation and several subsidiary companies. He pointed out that of all the tariff provisions, paragraphs 27 and 28 which cover coal tar products stand alone in naming the higher United States value as a basis for import taxes.

Mr. Metz stated that the incoming dyes which are in fact competitive constitute but two per cent of the domestic demand. He therefore requested that duties be based on foreign market value as for other commodities or on some United States price other than that provided in the present act.

Merck & Company request that strychnine and salts thereof now at 15c. per oz. be taxed at 25c.

For the organic chemicals, A. Cressy Morrison of the Carbide & Chemical Corporation, asked upward revisions in the acetaldehyde group. Maj. T. P. Walker of the Commercial Solvents Company spoke for protection on the alcohols and esters.

Cresylic acid and cresols are now at 20 per cent ad valorem and 3½c. per lb. specific. The Mathieson Alkali Works recommend no change but want ortho cresol mentioned in the cresol paragraph. The Internal Combustion Tar and Chemical Company protest against any lowering of rates and the Barrett Company wants present duties maintained on tar acids.

A duty increase from 25 to 50 per cent was asked on ethyl chloride in tubes by the Franco-American Chemical Works.

Sparklets, Inc., want liquid carbonic-acid gas under pressure now at 25 per cent to be put on the free list.

Increases on artists' colors and toy paints are asked by some producers and opposed by importers. Several manufacturers want 6c. per pound on ultramarine blue. Stanley Doggett, Inc., however, recommends that the change be from 3c. to 15 per cent ad valorem, a reduction. The present rates on umbers and siennas are supported by Reichard-Coulston, Inc.

Wishing to protect "precipitated bone phosphate" or "dibasic calcium phosphate," and the raw materials thereof, the Lucidol Corp. indorses the position of the Manufacturing Chemists Association that the basket clause rate be advanced from 25 to 40 per cent. More on the subject of fertilizer materials is expected when commodities on the free list come up for discussion.

AN INCREASE from ½ to 1c. per lb. on sodium phosphate was recommended by C. R. De Long, representing several manufacturers. Upward revision on disodium phosphate was protested by the Piece Dyers and Finishers Protective Association. The Warner Chemical Company and the Victor Chemical Works want a separate classification for the expensive sodium pyro phosphate to prevent its importation as sodium phosphate. Their suggestion would put it in the 25 per cent basket clause.

An increase of 3c. per lb. on salt, making a total of 10c. on salt in bulk and 14c. in packages, was advocated by the International Salt Company and others.

Protection of at least $5 per ton is wanted on sodium sulphate by the Myles Salt Company. Salt cake importations from Germany furnish serious competition. That the rate of 1½c. per pound be removed from sodium chlorate is asked by the Chipman Chemical Engineering Company and the Moscow, Idaho, Chamber of Commerce who wish cheap weed killing chemicals.

G. S. Robins & Company urge adequate duty of unspecified amount on potassium nitrate, feeling the effect of heavy saltpeter shipments from Germany.

The Barium Reduction Company and others want a stiffening of the rates on barium products. The Oakland Chemical Company dissents on the matter of barium oxide, now in the 25 per cent basket clause, asking the specific rate of 1½c. per lb., equivalent to the present ad valorem, if any change is made.

Rohm & Haas desire cuprous oxide to be taken from the basket clause and assessed at 40 per cent.

August Kochs for the Victor Chemical Works asked that formic acid be transferred from 25 per cent to 6c. per lb. as in the comparable case of oxalic acid to maintain production in America.

An increase of 1.45c. per lb. on calcium arsenate was requested by the Jardine Mining Company, which also want arsenious acid, now duty free, levied at 4c. The Commercial Chemical Company of Tennessee concur in the latter request but want white arsenic kept on the free list.

The increase in the fluorspar rate from $7.50 to $10 per ton proposed by the Hillside Mines was contested by the United States Smelting, Refining and Mining Company who want no upward revision for acid spar to be used in producing hydrofluoric acid and calcium fluoride.

On tartaric acid, the Royal Baking Powder Company requests a raise from 6 to 9c. per lb., and cream of tartar 5 to 7½c. Wine lees, argols, and other raw material now at 5 per cent are desired free. The Bristol-Myers Company, which uses tartaric acid in sal hepatica, think that the change on this item should be downward if any. The Harshaw, Fuller and Goodwin Company advocated that rochelle salts or potassium-sodium tartarate be raised from 5 to 7½c. per lb.

A reduction in the duty on lithopone was requested by the C. J. Osborne Co. The American Zinc Institute asks no change unless the raw material rates are increased, in which case a compensatory duty on lithopone is recommended.

American Ceramic Society Meets in Chicago

CHICAGO, during the week of Feb. 5 to 9, was the scene of the 31st annual meeting of the American Ceramic Society, held at the Hotel Stevens, concurrently with meetings of eight other organizations in other fields. These included industrial associations from the clay products, refractories and abrasives industries. The American Ceramic Exposition, which included well over 100 exhibitors, took place under the auspices of the Ceramic Society at the same time.

In addition to papers covering problems of the individual industries, the question of unification of research to eliminate duplication of effort was considered. First steps toward the formation of a central research control were undertaken. As part of this step, the Refractories Institute has become more closely affiliated with the refractories division of the Ceramic Society.

The Ceramic Society elected, as president, Prof. G. A. Bole of Ohio State University, and as vice-president, E. A. Harvey. R. C. Purdy and H. B. Henderson continue as secretary and treasurer, respectively.

NEWS FROM WASHINGTON

By Paul Wooton
Washington Correspondent of Chem. & Met.

ALTHOUGH it has been realized for a long time that tariff revision could not be postponed beyond this year, it has been the idea of the majority leaders that changes could be confined to relatively few paragraphs outside of the agricultural schedule. Their thought was that the 1922 tariff in most of its provisions is satisfactory. They felt that it would be necessary only to extend all the protection, within reason, that could be granted agriculture, to strengthen the textile schedule somewhat and to close the gaps where weak places have developed. Now they find themselves confronted with a deluge of requests for increases to say nothing of proposals affecting the type of valuation; infringement on American patents; the granting of protection against acts of foreign cartels and of meeting the demand for duties on products of the Philippines.

Despite the fact that there is little organized opposition to increases in tariff rates, it is known that the Republican members of the Ways and Means Committee are going to scrutinize increases with greater care than ever before. They realize that Democratic influence is being used in an effort to push certain rates to unstable heights, with the idea that popular opposition will be aroused to the majority party. As a result the Republican leadership in both Houses will have to be doubly convinced before recommending increases. While the number of increases that are likely to be allowed will be greater than those at first supposed, it seems very certain that few increases will be allowed outside of those paragraphs covering articles being subjected to very little foreign competition.

Although the formal discussion of American valuation is scheduled for February 25, witnesses, recognizing the importance of the administrative features, are expressing views in that connection. Certain manufacturers have asked that the American valuation be uses as a basis for ad valorem duties. Others strongly favor the use of the selling price in the United States as the basis for the duty.

THE Ways and Means Committee in 1921 made a special study of American valuation. At that time there was great doubt as to the workability of such a plan, largely because of the lack of comparability in novelties and other articles imported in large volume. The United States selling price plan also presents difficulties with commodities imported in various grades and on which the price depends to a considerable extent upon the volume of the sale. While indications are that the foreign valuation will continue to be the method employed in the calculation of most duties, it is regarded as entirely possible that further exceptions will be made. American valuation has worked out satisfactorily in connection with paragraphs 27 and 28 of the chemical schedule and in connection with a few products that were acted upon under the flexible provisions of the act. While this is the majority opinion, Eugene R. Pickrell, representing the General Dyestuff Corporation, which is the exclusive importer of I. G. dyes, took issue with that connection. He claims the American selling price provision has given rise to more protests and customs litigation than arose in connection with previous tariff acts. "American valuation as applied to dyestuffs," Mr. Pickrell said, "stifles progress, for the standard of comparison is the domestic product. The imported dyestuff may be a recent development considerably superior to the domestic product. Notwithstanding its superiority, the duty is based upon the selling price of the domestic product." He made the further point that where a dye is made by only one domestic producer that it gives him the power, by changing his selling price, to dictate the customs duty on the imported dyestuff. He contended further that it was too complicated for successful administration and is less to be desired than an embargo. Despite the point made against it, there is every reason to believe that the committee will recommend the continued use of the American selling price and United States value in connection with the coal tar paragraphs.

A DETERMINED effort is being made to have the ad valorem rates in the new tariff applying to woolen and worsted fabrics based upon the American selling price of the domestic product, with which the imported articles are competitive or comparable. When rates are assessed upon the declared foreign value, it was said in behalf of this proposal in the course of testimony before the committee, that there is "absolutely no control by the United States over the actual amount of duty to be paid. It places a premium upon the products of the country with the cheapest labor."

In connection with the administrative provisions it seems likely that the committee will recommend a definite and clear-cut provision to protect American patents against infringement. It is believed that there will be specific mention in the new law of patent infringement to take the place of the broader provision of the present act dealing with "unfair acts in the importation of articles into the United States." Apparently there is a growing tendency on the part of unscrupulous persons abroad to infringe upon an American patent, particularly when it is about to mature, and rely upon the disinclination of the owner to start litigation which probably would not be concluded prior to the expiration date of his patent.

Another problem with which the committee is wrestling is the working out of a plan which will grant protection against the acts of foreign cartels. The problem is a difficult one, particularly in the case of complete monopoly control, but an attempt will be made to reach this situation by a requirement that the invoice price must not be lower than that of similar goods sent to other consuming countries. This particular question has become more acute with the trend among the raw material cartels to extend their activities to the production and sale of finished products.

The production of furfural by scientists in the United States Department of Agriculture at Washington is cited by the Institute for Government Research, in a recent monograph on the Bureau of Chemistry and Soils, as an example of how the agricultural chemists have converted various farm wastes into useful articles of commerce.

Although farm wastes contain pentosans, and pentosans may be converted to furfural by a simple acid distillation, the institute points out that the Government's chemists were the first to produce furfural on an important commercial scale.

"The present American output of furfural," the institute's publication says, "is more than a half million pounds, with an average selling price of 10 to 17 cents a pound. Before 1922, when the color laboratory of the Bureau of Chemistry and Soils started work on the production of furfural, it was a chemical curiosity valued at $30 a pound.

IN connection with its consideration of the application of the Grasselli Chemical Company, of Cleveland, for an increase in the duty on barium chloride, the United States Tariff Commission has called a public hearing to be held in Washington March 5. Interested persons will be asked to testify as to domestic costs for 1927 and for the first six months of 1928. Information will be sought as to invoice prices of imported barium chloride and as to the principal markets in this country for the domestic and for the imported article. An effort also will be made to establish if there are differences in the quality of the domestic and imported material.

Under the present tariff barium chloride is dutiable at one and one-fourth cents per pound. This was an increase of one cent over the Underwood act. The Tariff Commission has issued its preliminary statement covering its findings as to costs of production. From the figures thus gathered it is calculated that the cost of production in this country is one and seven-eighths cents per pound greater than the cost of production in Germany or Belgium.

Recovery of Acetic Acid Increased in French Rayon Industry

New Methods Give Satisfactory Results—French Output of Aluminum Enlarged

From Our Paris Correspondent

THE Société l'Aluminium Français has just published an interesting little book entitled "Aluminium and Its Alloys" which gives detailed information on this industry. Aluminum was first made in 1853 by the French chemist Sainte Claire-Deville by action of sodium on mixed chloride of aluminum and sodium. This process was used and controlled by the Pechiney Co. until 1888 when it was replaced by a new process, simultaneously discovered by Héroult in France and Hall in the United States, the electrolysis of melted alumina in presence of cryolite.

Alumina is made from bauxite through the Bayer process consisting in the treatment of crushed bauxite under a pressure of 160 deg. C. The aluminate solution, separated from the non-aluminous oxides, is then decomposed by mechanical stirring; the alumina thus separated is filtered and calcinated at 1,200 deg. C. Two tons of bauxite are necessary to make one tone of alumina and 8 tons of different fuels for 1 ton of finished metal.

Thanks to the electrolytic process the ouput of aluminum has risen from 15 tons in 1885 to 15,000 tons in 1914, 20,000 tons in 1924 and 35,000 tons in 1928 for the French industry only. The home market needs only 50 per cent of the home output but new works are to be built in order to supply the growing demand of the market due to increasing use in the motor and flying trades and still keep up the necessary margin to supply foreign demands. Among aluminum alloys of current use are bronze containing 8 per cent of aluminum and 2 per cent of manganese which are used in France for the manufacturing of 50-centime, and 2-franc pieces; these aluminum-bronze coins have replaced the pre-war silver coinage.

Another aluminum alloy frequently used is duralumin which contains copper and magnesium and is gradually replacing wood in the manufacture of aeroplane screws or helixes. It is also largely used in the rayon trade in the manufacture of spinning bobbins, rollers of washing and drying machines, centrifugal apparatus, etc. It is not easily corroded by diluted acids, sulphur of sodium, alcohol, ether, etc. Alkaline solutions, however, should be avoided. Other uses of alumina are in the manufacture of aluminum papers and in the paint and varnish industries.

IN October 1928 the largest producers of mercury, Spain and Italy, entered into a two-year agreement and established a sales office at Lausanne, Switzerland, which quotes their prices for all consuming markets. France is entirely dependent on imports of mercury for her needs (about 15 million French francs worth per year). In 1926 France produced 2,600 kg. of Algerian mercury; in 1927 the home output was even lower at 1,000 kg. the home needs being 2,269 q.m. The present price of mercury in France is 37 French francs per kilo, in 1913 1 kilo was worth 5 gold francs (about 25 French francs of today), a formidable increase on pre-war prices. Mercury does not pay duty when imported in France.

MANUFACTURE of acetate silks is steadily increasing. The Rhodiaseta Co., which, with the Tubize Co. manufactures this kind of rayon in France, has made several agreements with foreign firms; at Fribourg in Germany namely, also in Belgium, in the United States and in Italy. In the latter country the Italian Rhodiaseta has increased its capital from 5 to 45 million, its objectives being the daily production of 2,500 kg. of acetate silk with a gradual increase up to 5,000 kg. daily. The recovery of acetic acid under such circumstances becomes a most urgent problem, large quantities of acetic acid being necessary for the manufacture of cellulose acetate, the basic raw material for acetate silk.

Up to now, recovery was made by neutralization with lime, the acetate of lime being evaporated and then distilled with sulphuric acid, or by direct distillation of the diluted acetic acid. Commercially, both methods are unsatisfactory. New methods make use of solvents. One of these methods recommended by the Distillerie des Deux-Sèvres makes use of ethyl acetate as a solvent. This ethyl acetate draws out acetic acid mixed with a little water; this solution is then distilled by a special apparatus. Ethyl acetate draws the water out of the mixture, leaving regenerated highly concentrated acetic acid and the recovered ethyl acetate can again be used in the manufacture of acetate silks. According to recent information, this process experimented at length on a semi-industrial basis gives satisfactory results. It will be used on a large scale in France by the Rhodiaseta Co. and the Tubize Co., also outside of France by the Courtauld Co. and the Soie de Chatillon Co. Apparatus of a capacity of 5 to 14 tons of acetic acid will be built by the aforesaid firms. Another process, the Suida process, making use of cresols as solvents is also being tested on a semi-industrial basis in France. The late Dr. Bronnert, one of the rayon industry pioneers, who died quite recently, had adopted the viscose process in his rayon works of Strasbourg.

A special spindle for viscose process has been devised by Mr. Brandwood; it allows the finishing, washing, bleaching and dyeing of rayon on the spindle itself. This spindle is being tested at the Aubenton and Soie de Compiègne works.

Prices have fallen both in the acetate and the viscose silk industries owing to the general unfavorable situation of the textile industry, and profits have naturally lessened accordingly.

News in Brief

PROFESSOR G. S. WHITBY, of the Chemistry Department of McGill University, has been awarded the first Colwyn gold medal, a prize founded last year by Lord Colwyn for conspicuous services of a scientific or technical nature dealing with the development of rubber manufacture or production. Professor Whitby has been engaged in research dealing with the problems of vulcanization, synthetic rubber and cognate colloid chemistry.

IN 1927 THE PRODUCTION OF LITHOPONE in Germany by fourteen operating plants, twelve of which are combined in Lithopone-Kontor, was approximately 65,000 tons taken on the basis of the Red Seal 30 per cent brand. This quantity represents a valuation of from 27,000,000 to 28,000,000 marks.

THE BILL PROPOSING THAT $150,000 be authorized for research work dealing with the recovery of potash from leucite, alunite and other potash-bearing minerals has been reported favorably by the Committee on Mines and Mining of the Senate. The bill, which provides for the conduct of the research work jointly by the Department of Commerce and by the Department of the Interior passed the House May 21, 1928.

THE KAURI GUM EXTRACTING WORKS at Babylon, New Zealand, recently began production of Kauri gum from the roots and limbs of trees. The process consists of chipping, followed by treatment with the solvents, alcohol and benzol. The gum is run into 200-pound drums, made on the premises, and in a few hours sets hard, the complete process occupying twenty-four hours. By a special steaming process the alcohol is recovered in a diluted form and the chips are carried in trucks to the boiler house, to be burned with a mixture of coal.

SUBSIDIES FOR THE MANUFACTURE and exportation of plate glass have been authorized in Chile, according to the Department of Commerce. This measure provides that the concern giving the Government the best guarantee to manufacture and export plate glass, locating their plant in the section of the country where the best advantage can be taken of native raw materials, will be given a bounty on both production and exportation.

New Process for Producing Adipic Acid Used in Germany

Lower Prices Enlarge Commercial Possibilities of the Acid and its Derivatives

From Our Berlin Correspondent

ADIPIC acid and its derivatives, known as adipinic acid in Germany, have recently become products of more general importance. The Deutschen Hydrierwerke, which have specialized in the hydrogenation of benzol, naphthalene and homologs, have developed a new process, presumably through the oxidation of one of these products, which now makes these substances available at comparatively low prices. Since extended experiments have shown that the physiological action of adipinic acid is harmless, it can be used for many purposes for which tartaric acid has formerly been used; this suggests its use in the baking powder industry, for beverages, for medicinal purposes, etc., and the more forcibly since its price is lower than that of tartaric acid.

In the baking powder industry it is superior to tartaric acid only to a slight extent, 100gr. liberating 60.27 kg. of carbon dioxide as compared with 58.66. Its difficult solubility in cold water is a disadvantage. In the lemonade industry the use of water soluble homologs is preferable, for example, β-methyl adipinic acid, which may be derived from methylcyclohexanol or even from cresols. In the latter case it is associated with acetylvaleric acid, but this type of mixture can find application in the textile, leather, and other industries.

Of comparatively great importance, however, are the esters of adipinic acid. Foremost among these are the neutral esters of cylic alcohols, which can be used as gelatinizing agents in all industries, such as the celluloid, artificial leather, lacquer, film, nitrocellulose, or cellulose industries, which have hitherto resorted to camphor and expensive substitutes for camphor. The methylcyclohexylester (Sitilan) dissolves not only cellulose esters but also rubber. It is used in the manufacture of leather-oils and varnishes, because of its softening effect which remains even at low temperatures, a property of value in the manufacture of belts. Sitilan can be used as an adhesive for celluloid and similar materials. The product obtained through the esterification of adipinic acid and glycerine is at first a plastic mass but hardens subsequently to a point where it might be used as a substitute for resin, rubber, etc. These specifications, however, do not exhaust the possibilities of application of this group of products and new developments may be constantly looked forward to.

The Lonz Electric Works have brought out a new fuel under the name "Meta." Chemically it is metaldehyde and is produced first by the action of water on acetylene in the presence of mercury compounds. The resultant acetaldehyde is now treated with sulphuric acid in cast iron vessels at —150 deg. C., and metaldehyde obtained. The heat value of Meta is 6136 Cal. per kg.

AT THE convention of the Reichsausschuss für Metallschutz recently held, the topic of pipe corrosion received extensive treatment. F. Besig, in speaking of various means of prevention, mentioned rust-proof steel as a possible but still expensive expedient. Asphalt layers are not wholly satisfactory, but a process of cold application of asphalt has achieved better results. Rubber packing has been successful in the case of water mains. The influence of depolarization on rate of corrosion was studied by F. Todt, who proved that the corrosion of iron, arising from electrochemical sources and from local oxygen currents, can be measured directly by way of the oxygen. To this end iron is coupled with copper or platinum and used to measure the current strength, which is an indication of corrosion. From it a continual check can be made on the factors preventing or modifying the attack, such as the generation and disappearance of layers. The question of minium for protective painting was discussed by A. Junk. He found that the highly dispersed varieties on the market at the present day have an oil requirement of 28 per cent as contrasted with 15 per cent formerly. Also the technical advantages are not wholly on the side of the modern product.

At the eleventh general meeting of the Brennkrafttechnischen Gesellschaft a paper was read by J. Bronn, Charlottenburg, on the chemical exploitation of coke gas. At the instigation of J. Bronn and the Concordia Bergbau A.G. an installation was made in Munich by the Gesellschaft für Lindes Eismaschinen A.G.

WITHIN the past few years this new process has found wide application in Germany as well as in other countries. In Germany alone within the course of the past few years, thirteen installations have been erected by four firms, the greater portion of which are already in operation. Each one of these installations has an annual capacity of 39,000,000 cu.m. of gas, so that already a yearly total of a half million cubic meters of coke-oven gas can be processed. Since one-half cu.m. of pure hydrogen can be produced from one cu.m. of coke oven gas in this way, the hydrogen generated can suffice for an annual production of almost a half million tons of ammonium sulphate. The cooling of coke oven gas according to this process proceeds in such a way that at first the heavy hydrocarbons condense, a sort of Blau gas, similar to that used as fuel on the Zeppelin dirigibles, being obtained. Subsequently a mixture is condensed which is very rich in ethylene and finally an almost pure fluid methane is procured. A gas remains at this point which is only a mixture of hydrogen and nitrogen, in such a pure state, however, that it can be directly used for the well known synthetic-ammonia processes.

In a few installations, for example, at the Concordia Bergau A.G., and the Teerverwertung at Meiderich, the product is not a mixture of hydrogen and nitrogen but pure hydrogen. The very low temperature necessary for separating the nitrogen is obtained by vaporization of the liquid nitrogen used as cooling baths under vacuum. The hydrogen generated in this way is wholly free of water vapor.

In the installation erected by the "Teerverwertung" the hydrogen is to be used for the liquefaction of coal according to Bergius' process. Since the Linde Company succeeded in creating a dependable apparatus for the separation of various kinds of gases, the initial part of the problem of exploiting coke-oven gases to their potential extent has now been satisfactorily solved.

On the other hand, other hydrocarbon gases, especially methane and ethylene, which also occur in great quantities and in a pure condition, are still applied only as common fuels.

Production of Lampblack Larger in 1927

THE Department of Commerce announces that, according to data collected at the biennial census of manufactures taken in 1928, the total production of bone black, carbon black, and lampblack in 1927 was valued at $14,461,584, an increase of 6.2 per cent as compared with $13,614,319 for 1925, the last preceding census year. The 1927 total includes $2,049,755 representing the value of bone black and lampblack made as secondary products by establishments engaged primarily in the manufacture of other commodities of the 67 establishments engaged primarily in the manufacture of these products, 34 were located in Louisiana. Production figures for 1927 and 1925 were as follows:

Production of Bone Black, Carbon Black, and Lampblack

	1927	1925
Bone black, carbon black, and lampblack made in all industries, aggregate value	$14,461,584	$13,614,319
Made in the bone-black, carbon - black, and lampblack industry, value	$12,411,829	$10,990,186
Made as secondary products in other industries, value	$2,049,755	$2,624,133
Carbon black:		
Pounds	198,429,000	177,417,378
Value	$10,955,000	$9,639,585
Bone black:		
Pounds	58,159,476	64,135,425
Value	$2,466,343	$2,539,704
Lampblack:		
Pounds	8,800,366	12,031,745
Value	$1,040,241	$1,435,030

MEN *in Chemical Engineering*

FIRMAN E. BEAR, who has been head of the soils department, Ohio State University, has resigned to become director of agricultural research of the American Cyanamid Company, effective July 1, 1929.

WILLIAM LLOYD EVANS, chairman of the department of chemistry at Ohio State University, is recipient of the Nichols medal for 1929. The award, which will be conferred on March 1 in New York, was made in recognition of Dr. Evans' work on carbohydrates.

H. L. ROBSON of Richmond, Calif., has joined the Synthetic Iron Color Company, manufacturers of pigments. He continues as consultant of the Burnham Chemical Company where he had been chief chemist.

O. S. SLEEPER, long active in the chemical plant and equipment field, has become associated with the F. J. Stokes Machine Company and is located in the company's building in Philadelphia.

R. B. STRINGFIELD, chief chemist of the Goodyear Tire and Rubber Company of Calif., has resigned to accept a similar position with the Golden State Rubber Mills, Los Angeles, Calif., formerly the Long-Turney Corporation, where he will head all technical activities.

J. T. WARD, who has been professor in charge of the graduate course in fuel and gas engineering at the Massachusetts Institute of Technology, has resigned to take up technical work with the M. W. Kellogg Company, with headquarters at Jersey City, N. J.

J. J. WILLAMAN has resigned from his position as professor of agricultural biochemistry at the University of Minnesota to become chief of the chemical division at the Agricultural Experiment Station, Geneva, New York, where he will take up his new duties April 1.

C. A. DUTTON, formerly with the Carborundum Company, has become associated with the Ferro Enamel Supply Company as a member of its furnace department.

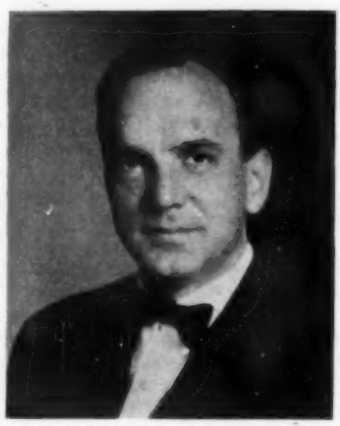
FREDERICK S. BACON has left the employ of Arthur D. Little, Inc., Cambridge, Mass. to join the production department of the Monsanto, Ill., plant of the Monsanto Chemical Works. He is supervisor of ortho and para nitraniline production.

RALPH E. GATES, who was chemist for the Sun Oil Company, at Yale, Okla., has gone to Paulsboro, N. J., at the laboratory of the Vacuum Oil Co.

J. H. INGMANSON, formerly works manager for the Crown Chemical Corporation, Keyport, N. J., has joined the Bell Telephone Laboratories, New York.

R. M. BURNS, head of electrochemical and corrosion research for the Bell Telephone Laboratories, has visited New Orleans for the study of corrosion problems there.

FRANK CLIFFORD WHITMORE, for four years head of the chemistry department of Northwestern University, has received appointment as dean of the school of chemistry and physics at Pennsylvania State College, to begin on July 1 this year. He succeeds Dean G. L. Wendt who was appointed assistant to the president of the college in charge of research. Dr. Whitmore's wide experience in teaching was gained at



F. C. WHITMORE

Harvard, Williams, Rice Institute, Minnesota, and Northwestern; of his numerous other activities perhaps the freshest in the minds of his acquaintances is his leadership of the Institute of Chemistry at Evanston last summer.

CALENDAR

AMERICAN CHEMICAL SOCIETY, 77th meeting, Columbus, Ohio, April 29-May 3, 1929.

AMERICAN ELECTROCHEMICAL SOCIETY, spring meeting, Toronto, May 27-29, 1929.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, mid-year meeting, Philadelphia, June 19-21.

AMERICAN INSTITUTE OF CHEMISTS, annual meeting, New York, May 4.

SEVENTH COLLOID SYMPOSIUM, Baltimore, Md., June 20-22.

TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRIES, annual meeting, New York, Feb. 19-21.

TWELFTH EXPOSITION OF CHEMICAL INDUSTRIES, Grand Central Palace, New York, May 6-11, 1929.

IRVING LANGMUIR, prominent for nineteen years in research for the General Electric Company, is the newly elected president of the American Chemical Society. He succeeds Prof. S. W. Parr, of the University of Illinois.

SIDNEY B. HASKELL has been elected vice-president of the Synthetic Nitrogen Products Corporation, for which he had directed the agricultural department for a year. Previously Dr. Haskell had spent seven years as director of the Massachusetts Agricultural Experiment Station, with charge at the same time of fertilizer control in that state.

FRANCIS P. GARVAN and MRS. GARVAN were awarded the American Institute of Chemists medal, for "outstanding service to the science of chemistry and profession of chemist in America." The award, the result partly of their support of the Chemical Foundation, will be officially bestowed at the Institute's annual meeting on May 4.

J. SPOTTS MCDOWELL has been appointed director of its enlarged research facilities by the Harbison-Walker Refractories Company, Pittsburgh. After his graduation from the Massachusetts Institute of Technology Mr. McDoweli twenty years ago began his career with this company.

A. E. HALL, for a number of years with the New Jersey Zinc Company at Palmerton, Pa., has left to become manager of the Navicoal Corporation, Perth Amboy, N. J., a subsidiary of the Lehigh Coal and Navigation Company.

WILLIAM L. SPALDING, formerly of Buffalo, has become chemical engineer with the American Cyanamid Company at Warner's, N. J.

FRANK T. SHUTT, of the Canadian Experimental Farms system, has received an award of $1,200 from the Nitrogen Research Committee of the American Society of Agronomy for outstanding achievement in nitrogen research.

H. BURTON LOWE is a newly appointed vice-president of the Chemical Catalog Company, for whom he had been New York district manager for several years.

E. B. REESER, president of the Barnsdail Corporation and an active leader in oil conservation movements, was elected president of the American Petroleum Institute at its December meeting in Chicago.

FRANK N. SPELLER, director of the department of metallurgy and research of the National Tube Company, has been elected chairman of the metallurgical advisory board to the Carnegie Institute of Technology and the U. S. Bureau of Mines.

EARNEST WANDER, for many years with the Monsanto Chemical Works, has resigned in order to join the Bay Chemical Company of New Orleans as superintendent of the sulphate and acid plants at Weeks, La.

R. E. WILSON

R. E. WILSON, head of the research department of the Standard Oil Company of Indiana, has been appointed assistant to the vice-president in charge of manufacturing. Dr. Wilson has been with this organization since 1922, having come there from an associate professorship in chemical engineering at the Massachusetts Institute of Technology. In his present capacity he will direct the new development and patent department of his company.

LEE T. SMITH, until recently with the Hercules Powder Company at Kenvil, N. J., has now become research chemist for the Goodyear Rubber Company.

OBITUARY

VICTOR C. EDWARDS, chemical superintendent of the du Pont Viscoloid Pyralin Company, at Arlington, N. J., died suddenly at his home on Dec. 20 of a heart attack. He had been with the du Pont company in this branch for eight years, having spent three years previously developing chemical processes on semi-works scale. Dr. Edwards was a native of North Carolina, where he also received his schooling and spent a few years teaching prior to entering industry.

SIR JOHN BRUNNER, for many years a director of Brunner, Mond & Company, and the I.C.I., Ltd., died on January 30 in London. He was the eldest son of Sir John Brunner, co-founder with Dr. Ludwig Mond of the Brunner, Mond firm.

ANDREW JERGENSEN, president of the soap company bearing his name, died at Sarasota, Fla., on Jan. 11. Resident in Cincinnati he began manufacture there in 1881 and developed a large toilet soap business.

C. G. FRANKLYN, former president and organizer of the Municipal Gas Light Company, died in New York at the age of 84. Mr. Franklyn was instrumental in the development of New York's gas industry, and through him in 1878 came the adoption of new water-gas processes, followed in 1884 by the formation of the Consolidated Gas Company.

FRANKLIN H. KALBFLEISCH, founder of the Kalbfleisch Corporation, manufacturers of chemicals, died on Jan. 30 at his home, Larklawn, L. I., at the age of 82.

He was born in Brooklyn in 1846, with a family tradition of chemical manufacture already behind him. His father, coming from Holland in 1829, had managed a chemical plant owned by the Chemical National Bank of New York and there had produced sulphuric acid and dry colors. In 1870 the three sons succeeded to the business that he had since developed and this, together with new organizations, subsequently comprised the Kalbfleisch Corporation. Mr. Kalbfleisch remained active as the head of his firm until 1920, when he retired due to ill health.

SAMUEL WYLIE MILLER, since 1921 consulting engineer of the Union Carbide and Carbon Research Laboratories at Long Island City, died on Feb. 3 at his home in Hollis, L. I. A native of New York, he had received his engineer's degree from Stevens Institute in 1887 and soon became one of the forerunners in the field of oxyacetylene welding. Realizing its possibilities, he made welding the subject of his special study and contributed largely to its development. Before joining the Union Carbide Company he was with the American Locomotive Company and the Rochester Welding Works, which he founded.

R. L. WELSH, secretary and general counsel of the American Petroleum Institute, died on Jan. 21 at Phoenix, Ariz., where he had gone from New York to regain his health.

JESSE L. JONES, chief chemist of the Westinghouse Electric and Manufacturing Company, died on Jan. 21 at Green Cove Springs, Fla. He was 63 years old and had been with his company since 1902, having come there from a course at Ohio State University and several years of laboratory experience.

WILLIAM PRESCOTT, retired leader in the fertilizer industry, died on Dec. 30 at his home in Cleveland, Ohio. He was one-time owner of the Cleveland Drier Company.

W. W. PICKENS, president of Davison-Pick Fertilizers, Inc., New Orleans, died at his home on Dec. 26. He had been intimately associated with the fertilizer industry for 30 years.

A. V. FULLER, district chemist for the health department at Washington, died on Jan. 25 in his 45th year. He had served the government in various capacities until he joined the American Sugar Refining Company in New York, where he stayed until 1926.

LEONARD WALDO, during the war a consulting engineer for the War Department in the production of illuminants and shells and engaged in experiment for the Nixon Nitrogen Works, Raritan, N. J., died on Jan. 25 at Plainfield, N. J., 75 years old.

INDUSTRIAL NOTES

CUTLER-HAMMER, INC., is the new name of the Cutler-Hammer Mfg. Company, Milwaukee, Wis. Its officers are F. R. Bacon, chairman of the board, B. L. Worden, president, F. L. Pierce and J. C. Wilson, vice-presidents. The company also has purchased the Trumbull Vanderpoel Electric Mfg. Company, which will be operated under its present name.

THE DESPATCH OVEN COMPANY, Minneapolis, Minn., has placed H. C. Beck, 21 East 40th Street, New York, in charge of the New England and Atlantic territory.

THE SUN RUBBER COMPANY, Barberton, Ohio, has put its new department for molded rubber in charge of W. A. German.

THE WALWORTH COMPANY, Boston, has added R. J. Scanlan to its staff as sales engineer.

THE MINE & SMELTER SUPPLY COMPANY has moved its general offices to Denver, Colo. Its officers now are A. H. Seep, president, Clark Grove, executive vice-president, and H. J. Gundlach, general manager of merchandising.

THE C. F. PEASE COMPANY, Chicago, has opened an office at 501 Spring St., Los Angeles, under R. S. Gibson.

THE ROSSVILLE COMMERCIAL ALCOHOL CORPORATION, New York, has acquired the distillery of the Industrial Chemical Manufacturing Company at Mechanicsville, N. Y.

THE DURALOY COMPANY has moved its Chicago office to 608 S. Dearborn St.

THE KOPPERS COMPANY of Pittsburgh and the American Rheolaveur Corporation of Wilkes-Barre and New York City, have affiliated to form the Koppers-Rheolaveur Company. The affiliation was made to broaden the field for the cleaning and preparation of coal and the concentration of ores. The Rheolaveur process which is used was patented by Antoine France of Liege, Belgium, and since 1925 has been installed in a number of American plants.

HEAT TRANSFER PRODUCTS, INC., has become affiliated with the American Locomotive Company in whose plant all manufacturing will be done. Its offices are located at 30 Church Street and G. T. Jacocks remains as head under the new arrangement.

AMERICAN SOLVENTS & CHEMICAL CORPORATION now occupies the 32nd floor of the Chanin Building, 122 East 42nd Street, New York.

THE GEORGIA PINE TURPENTINE COMPANY has appointed Wishnick-Tumpeer, Inc., exclusive sales agents for its pine tar and pine tar oils.

NORTHERN EQUIPMENT COMPANY, Erie, Pa., has appointed Bradshaw & Co., Pittsburgh, to represent the Copes System of boiler steam control in the Pittsburgh district.

FOOTE BROS. GEAR AND MACHINE CO. have established a New York branch office in charge of E. A. Phillips in the Woolworth Building.

THE MERCO NORDSTROM VALVE CO. has opened new offices at 8 Clark Building, Pittsburgh, and at 2842 W. Grand Boulevard, Detroit.

MIDWEST PIPING & SUPPLY COMPANY, INC., St. Louis, specializing in oil refinery supplies, has placed E. A. Kerbey in charge of the Chicago office at 208 La Salle St.

THE C. H. WHEELER MANUFACTURING COMPANY, Philadelphia, has appointed W. K. Kirby, 309 American Exchange Bank Building, Dallas, Tex., for the distribution of oil refinery equipment.

THE LINCOLN ELECTRIC CO., Cleveland, Ohio, has appointed J. E. Drustine sales representative at Birmingham, Ala., and H. P. Egan as representative at Columbus, Ohio.

THE A. C. HORN COMPANY, Long Island City, N. Y., has appointed M. H. Schwartz sales promotion manager.

THE REITER COMPANY, Elgin, Ill., has changed its name to Elgin Water Softener Corporation, the descriptive features of which are already embodied in the unchanged trade mark.

THE WATSON-STILLMAN CO., New York, manufacturing hydraulic machinery, is represented by the Midvale Mining and Manufacturing Company at 705 Olive Street, St. Louis, Mo.

THE BAILEY METER CO., Cleveland, Ohio, has appointed the following as representatives: R. D. Knapp, 53 West Jackson Blvd., Chicago; C. M. Kunkel, 1201 W. Gray Ave., Houston, Texas; H. H. Gorrie, 402 Sharon Bldg., San Francisco, Calif.

MARKET CONDITIONS *and* PRICE TRENDS

Vegetable Oil Refining Affected by Cottonseed Supply

Total Output of Refined Oils Showed Decline Last Year

THAT VEGETABLE oil refining in this country is largely influenced by the size of the cotton crop and its consequent offerings of seed for crushing purposes, is well exemplified by the figures for refined oil production last year. With the exception of cottonseed oil, all vegetable oils were refined in larger amounts than was the case in 1927, yet the total output of refined oils in 1928 was almost 9.9 per cent below the production of 1927.

Production of crude oil also was adversely affected by the smaller stocks of cottonseed and the total domestic output of all crude vegetable oils in 1928 was 2,731,377,830 lb. This compares with totals of 3,044,979,072 lb. and 2,924,403,604 lb. for 1927 and 1926 respectively. Of interest in crude oil production, is the fact that domestic supplies of soya bean oil are increasing annually. This oil enjoyed a large consumption in this country while it was on the free list but the imposition of the existing duty placed it in a position of disadvantage from a price standpoint and relatively small amounts have been on the market in recent years.

ANALYSIS of the figures for oil production show a trend toward enlarged production of cocoanut oil. Cocoanut produced in the Philippine Islands still is allowed free entry into this country and in 1927, importations reached a total larger than the home output but this was reversed last year. Domestic production, however, is more or less dependent on competitive conditions as, at times, the price for copra is so high as to discourage importation and it is more economical to import the oil. The relationship between imports and domestic production of cocoanut oil in the last three years compares as follows:

Domestic Production and Imports of Cocoanut Oil

	Domestic Production Lb.	Imports Lb.	Domestic Production Per Cent of Total Supply
1926..	260,712,073	245,129,333	51.54
1927..	281,654,384	293,369,704	48.98
1928..	311,130,463	290,636,702	51.70

A notable increase in domestic production of castor oil was reported last year. Consuming demand for this oil are broadening and it is expected that the output will be maintained along the standard established last year. As castor beans, the raw material for castor oil, are not cultivated in this country, the increase in oil production necessarily demanded a corresponding increase in importations of castor beans which came largely from India and Brazil.

AS THE amount of oil refined in any year will vary according to the stocks of crude oil available it is evident that activities in the vegetable oil refining industry can not be extended at will but must depend to a certain extent on production and imports of crude oil. Within these limits, however, oil refining may be increased or decreased in accordance with consumptive requirements. Last year, consuming industries increased their demands upon refiners and as a result there was a gain in the output of refined oils with the exception of cottonseed.

Comparing the figures for domestic production of crude oils and the output of refined oils it will be found that in 1928 a relatively larger amount of crude oils went through the refineries. The comparison follows:

	Domestic Production Crude Oils Lb.	Domestic Output Refined Oils Lb.	Per Cent Refined
1926..	2,924,403,604	1,818,490,220	62.11
1927..	3,044,979,072	1,955,936,124	64.23
1928..	2,731,377,830	1,762,489,577	64.52

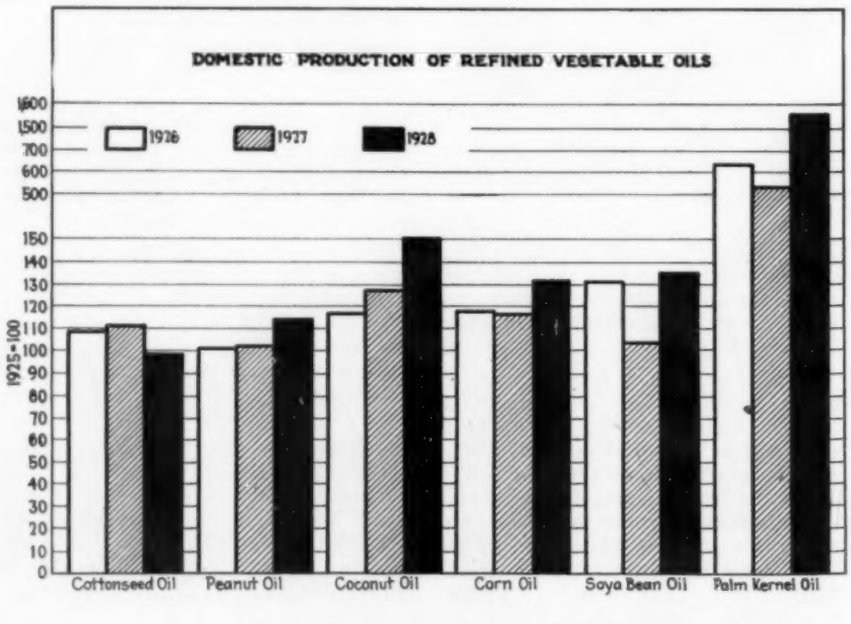
Statistics for production and refining of the individual oils are as follows:

United States Production of Crude Vegetable Oils, 1925-1928

	1925 Lb.	1926 Lb.	1927 Lb.	1928 Lb.
Cottonseed oil	1,510,802,294	1,760,529,592	1,804,106,156	1,460,407,149
Peanut oil	15,156,315	10,643,837	10,589,613	12,439,080
Coconut oil	207,604,172	260,712,073	281,654,384	311,130,463
Corn oil	104,153,260	120,041,335	117,440,681	121,686,657
Soya bean oil	2,519,938	2,645,514	3,087,670	4,715,908
Olive oil	550,135	1,401,098	856,588	1,451,111
Linseed oil	763,822,379	720,109,940	776,714,498	751,444,531
Castor oil	45,049,646	46,651,587	49,400,863	64,521,100
All other	1,119,317	1,668,628	1,128,619	3,581,831

United States Production of Refined Vegetable Oils, 1925-1928

	1925 Lb.	1926 Lb.	1927 Lb.	1928 Lb.
Cottonseed oil	1,345,461,442	1,471,369,351	1,592,413,987	1,328,279,276
Peanut oil	8,331,570	8,372,080	8,414,484	9,545,623
Coconut oil	197,118,259	231,235,560	251,199,842	296,650,404
Corn oil	79,624,310	93,704,161	92,870,623	104,487,221
Soya bean oil	5,501,481	7,253,250	5,681,408	7,440,573
Palm kernel oil	1,031,569	6,555,818	5,355,780	16,086,480



MARKET APPRAISAL OF CHEMICAL INDUSTRY

International Salt Co. reported net profit for six months ended December 31, 1928, of $344,477, compared with $118,456 for corresponding period of 1927.

Liquid Carbonic Corp. has concluded negotiations for the acquisition of all of the assets of the General Carbonic Co., including their 8 plants located at Long Island City, Albany and Buffalo, N. Y., Philadelphia, Norfolk, Va., New Orleans, Chicago, Ill., and Nashville, Tenn.

International Salt Co. and subsidiaries report for six months ended December 31, 1928, profit of $344,477 after expenses, fixed charges and sinking fund but before federal taxes, against $118,456 in corresponding period of 1927.

Procter & Gamble Co. has declared regular quarterly dividend of $1.50 on the 6 per cent preferred, payable March 15. The company has called for redemption on March 28 at 110.25, $3,160,100 6 per cent preferred.

Union Carbide & Carbon Co. has acquired Compressed Gas Corp. and subsidiaries of Denver, Col., the purchase to be effected through exchange of stock.

Surplus of Westvaco Chlorine Products Corp. and subsidiaries for year ended December 29, 1928, was $719,368 after interest, bond amortization, federal taxes and dividends on preferred stock, equivalent to $3.59 a share on 200,000 no par shares of common stock. Sales amounted to $5,215,866.

American Cyanamid Co. has arranged to purchase Calco Chemical Co. in exchange for 88,370 shares of the Class B common stock of American Cyanamid at the rate of 2½ shares of Class B for each share of Calco preferred and one share of Class B for each nine shares of Calco common.

Sherwin Williams Co. has declared an extra dividend of 25 cents on the common and the regular quarterly dividends of 75 cents on the common and $1.50 on the preferred A.

Financial reports from companies in the chemical and related fields reveal that, in the majority of cases, profits earned in 1928 were larger than those reported for the preceding year. Among the yearly statements which so far have been issued are the following:

	Profit 1927	Profit 1928
Air Reduction	$2,412,596	$3,208,993
Atlas Powder	1,984,952	2,093,953
Commercial Solvents	2,012,874	2,929,420
Devoe & Raynolds	930,122	1,079,573
Du Pont	45,947,832	64,097,797
Freeport Texas	3,735,602	3,275,576
Hercules Powder	3,203,895	4,038,980
Pratt & Lambert	1,325,656	1,432,924
Texas Gulf Sulphur	12,099,374	14,517,619

Price Range for 1928 High	Price Range for 1928 Low	Stock	Price Range in January Jan. 2	Price Range in January High	Price Range in January Low	Price Range in January Jan. 31
99⅜	59	Air Reduction	99⅜	111⅜	96⅞	109⅜
14⅜	7½	Ajax Rubber Co	10½	11⅞	9½	10⅜
252½	146	Allied Chemical	255	280	241	280
127⅜	120½	Allied Chemical, pf	121⅜	123	121	122½
26	15⅜	Am. Ag. Chemical	20⅞	23⅜	20½	21½
79½	55½	Am. Ag. Chemical, pf	71½	73½	67¼	69
65	30⅜	American Cyanamid, B	58½	80	50	68⅛
15⅜	8¼	Am. Hide & Leather	10	10	9	9
63¾	39	American Metals	62	74	60½	71⅞
28⅛	11⅜	Am. Solvents & Chemical	27⅛	37⅜	26½	35⅛
54	26½	Anglo-Chile Nitrate	33⅜	45½	33	41
112½	55½	Archer-Daniels-Midland	102½	110⅜	98½	101
33⅜	19½	Assoc. Dyeing & Printing	21⅜	26½	20½	23½
114	63	Atlas Powder	115	115	103	109
24½	12½	Beacon Oil	22	28½	21¾	22
101½	70⅜	Beechnut Packing	98	101	90	95
85½	65½	Bon Ami, A	94⅜	89½	83	84
97½	65	Bristol-Myers	94⅜	107½	92½	107½
36	25½	California Petroleum	....	29⅜	27	....
103	36½	Celanese	53⅜	53⅜	41½	44½
185½	100	Celanese, pf	117	117	111	115
64⅜	28½	Certainteed	78	92½	77½	89½
56½	45	Chickasha Cotton Oil	49⅜	50	46	48⅜
250½	137⅜	Commercial Solvents	239	248	227½	241½
94	64⅜	Corn Products	90⅜	91⅜	86½	88
68⅜	34⅜	Davison Chemical	59⅜	69½	59½	68½
61	40	Devoe & Raynolds	57	59½	55½	58½
120	108	Devoe & Raynolds, pf	....	115½	112	115
503	310	Du Pont	504	665	493	665
121½	114	Du Pont, 6 pc. db	117⅜	118½	115⅜	117⅜
194½	163	Eastman Kodak	181½	188	181½	184
259	166	Firestone Tire	243	250	225½	240
17⅜	8⅛	Fisk Rubber	16½	20½	15⅜	18½
89⅜	65	Fleischmann Co	83½	84⅜	77½	77⅜
109½	43	Freeport, Texas	50⅛	54⅛	48½	51
37	20⅜	Glidden Co	37⅛	44½	36⅞	41⅞
105	95	Glidden Co., pf	104	105	103½	....
143½	71	Gold Dust	145½	146	143⅜	....
109½	68½	Goodrich Co	105⅜	105⅜	94½	98⅜
167	76	Houston Oil	100	107	86⅜	89½
146	118	Industrial Rayon	121	135	121	129
20⅜	13	Int. Ag. Chemical	15½	17⅜	15	16½
85	48⅜	Int. Ag. Chemical, pf	84⅜	88½	83½	85½
34½	22	International Paper	31	35	27½	35
68⅜	49½	International Salt	....	76½	55½	75
25½	19½	Kelly-Springfield	23½	23⅜	20½	22
26⅜	17½	Lee Rubber & Tire	23⅜	25	21½	23
64⅜	38	Lehn & Fink	63½	68½	62⅜	64½
186	109	Libby-Owens	181	220	179	208⅜
124½	63½	Liquid Carbonic	109½	113⅜	103½	106
190	117⅜	Mathieson Alkali	181	216½	175	210⅜
98	36½	Monsanto Chemical	....	....	....	....
58½	29½	Nat'l Dist. Products	39	43⅜	37	39½
136	115	National Lead	132½	158½	132	148½
294	180½	New Jersey Zinc	289	325	279⅜	310
83½	58½	Ohio Oil	73⅜	74⅜	64½	66½
95⅜	74½	Owens Bottle	81⅜	95	81	91
116	112½	Palmolive Peet	....	....	....	....
53⅜	35½	Phillips Petroleum	45	47	37½	39⅜
69⅜	64½	Pittsburgh Plate Glass	74⅜	76⅜	74	74⅜
72½	51½	Pratt & Lambert	63½	82	63½	81½
31½	19	Pure Oil	27	28½	23½	24½
92	65½	Sherwin-Williams	....	88⅜	87½	....
29	17	Silica-gel	23⅜	28⅜	23½	28
46⅜	17⅜	Sinclair Oil	42⅜	45	36½	38⅜
42⅜	25	Skelly Oil	35½	40	34	35
80	53	Standard Oil, Cal	71½	73½	64⅜	66½
59⅜	37⅜	Standard Oil, N. J	54⅜	55½	49½	50½
45½	28⅜	Standard Oil, N. Y	45⅜	45⅜	40	41
7⅜	2½	Standard Plate Glass	4½	9⅜	4½	7½
77	31½	Sun Oil	65½	68½	60	61
23½	16	Swan & Finch	....	18	17½	....
19½	10½	Tennessee Copper & Chemical	19⅞	19⅞	17½	19
74⅜	50	Texas Corp	67½	68	59⅜	60⅜
82½	62½	Texas Gulf Sulphur	79⅜	82	76	78
25	14⅜	Tidewater Oil	21⅜	22	18	18½
630	450	Tubize Silk	520	550	490½	500
209	136½	Union Carbide	199	225	196½	224⅞
58	43½	Union Oil, Cal	51½	52½	48½	49½
120	52½	United Piece Dye	....	114	104	109½
138	102½	U. S. Ind. Alcohol	131	154⅞	128	151½
51	22	U. S. Leather	33½	35½	30⅜	30⅜
63½	27	U. S. Rubber	48⅜	55½	42	51⅞
111	72	Vacuum Oil	109⅞	130⅜	105½	121⅞
111½	60	Vanadium Corp	103	113⅜	95½	107⅜
85	58	Vick Chemical	84½	94½	82	88⅛
20⅜	12	Va.-Ca. Chemical	18⅛	24⅜	18½	22½
64½	44⅜	Va.-Ca. Chemical, pf	59⅜	65½	58⅜	63½
110	87	Wesson Oil	96½	107	93½	105½
16	11	Wilson & Co	12⅜	13½	11½	....
98.5	57.79	Average for 90 stocks	90.19	97.26	84.76	95.31

ECONOMIC INFLUENCES *on production and consumption of* CHEMICALS

Favorable Outlook for Chemicals in First Quarter of Year

Large Consuming Industries Are Maintaining High Rate of Production

MANUFACTURING industries which are large consumers of chemicals and related products entered the new year under favorable conditions and to date have been operating on a high plane of activity. The standards set up in the latter part of last year are being maintained and demand for chemicals promises to be larger in the first quarter of this year than it was in the corresponding period of 1928.

At the meeting of the Atlantic states Shippers Advisory Board, held January 18, reports were submitted by the different committees relative to the number of cars which would be required to transport different commodities in the first quarter of the year. These reports are interesting inasmuch as they give some indication of probable activities in chemical consuming and producing trades for the first three months of the year. A summary of the reports indicates that shipments of goods for the quarter will be larger than was the case a year ago. Referring to the chemical industry the following estimates of carload requirements are significant:

	Quarterly Total Carloads		Increase
	Actual	Estimated	
Commodity	1928	1929	Per Cent
Petroleum and products	51.374	57.539	12
Steel and iron	79.101	87.011	10
Lime and plaster	14.736	15.178	3
Automobiles and parts	10.628	11.159	5
Fertilizers	17.442	19.535	12
Paper, paper board, etc.	24.944	27.688	11
Chemicals	7.364	7.732	5

Other estimates bearing on consumption of chemicals for the quarter included: paints, oils, and varnishes, increase of 1½ per cent; pulp and paper, increase of 11 per cent; glass containers, increase of 10 per cent; clay and clay products, increase of 40 per cent; and hides, leather, and tanning materials, decrease of 22 per cent.

The rayon industry which offers a wide outlet for different chemicals has had considerable influence in expanding the output of chemicals in recent years. In 1924, domestic rayon production was reported at 38,850,000 lb. In 1928, the output had increased to 97,701,250 lb. Trade estimates placed production for the present year at 125,750,000 lb., or an increase of 28.7 per cent. This increase in rayon production, if it materializes, will mean that consumption in that industry, of chemicals and related products, will show a corresponding increase.

With an expanding export market, the manufacturing program in the automotive industry may be speeded up beyond the rate of operation last year. This has a direct bearing on production of many chemicals, solvents, lacquers, etc. It also means a more active, a much larger market for plate glass, which in turn reaches back to chemicals for its raw materials. It is estimated that operations in the automotive industry in January were 13 per cent higher than in January, 1928. Pulp and paper, textiles, rubber and glass manufactures progressed in a much more active way in January than in the corresponding period of last year. Leather and tanning activities offer an exception to the general rule and are falling behind the levels maintained a year ago.

INDUSTRIAL output during December, according to the weighted index of the Federal Reserve Board, showed a gain over both the preceding month and December, 1927, after adjustment for seasonal conditions. The principal gains over December, 1927, occurred in iron and steel, non-ferrous metals, tobacco manufactures, and automobiles. Mineral production, after adjustment for seasonal conditions, showed a decline from November but was almost 10 per cent greater than in December, 1927.

Stocks of commodities held at the end of 1928 were somewhat higher than at the end of the previous year. Inventories of raw materials and manufactured goods were each larger than a year ago, as likewise were the unfilled orders.

STATISTICS covering foreign trade in chemicals and related products for 1928 have just been issued and reveal a healthy condition both as regards export and import shipments. Exports for the year reached a valuation of $137,305,139 as compared with $132,250,932 for 1927, or a gain of 3.8 per cent. Imports in 1928 were valued at $143,041,303 compared with $129,857,442 for 1927, or a gain of slightly more than 10 per cent.

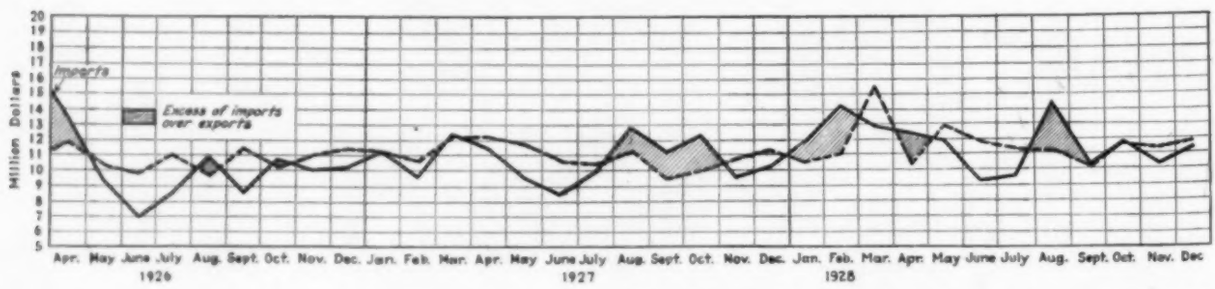
Export trade in the industrial chemical group was especially encouraging the totals for 1928 and 1927 being $25,687,043 and $15,488,132 respectively or a gain of 65.8 per cent for the year. Notable increases were recorded in potassium compounds with the rise in quantity being relatively larger than the increase in value. Sodium compounds accounted for nearly $2,000,000 of the increase in export trade, borax leading the group from a quantity standpoint and caustic soda holding the leading position with reference to value.

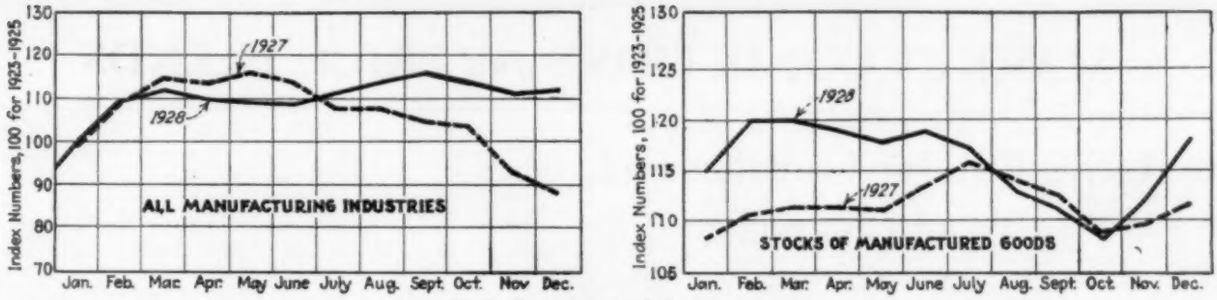
The pigment and paint group also showed expansion with exports of carbon black registering a gain of more than 40 per cent in volume.

In contrast, imports of industrial chemicals were valued at $24,203,068 in 1928 as against $28,504,365 in 1927 or a loss of more than 15 per cent. Imports of glycerin fell off heavily during the year. Bitartrate of potassium showed a decline of more than 50 per cent in quantity.

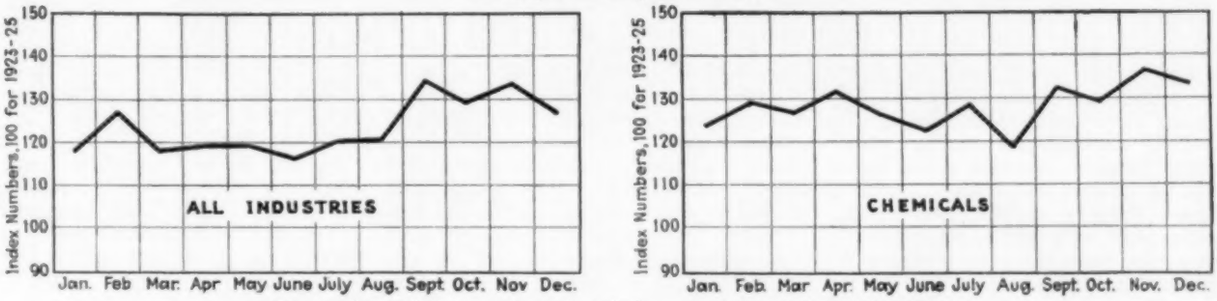
Fertilizer materials were imported in larger quantities last year, the total value being $77,913,299 as compared with $58,842,371 in 1927. Nitrate of soda, sulphate of ammonia, and potash salts aided to a large extent in the higher import total.

Foreign Trade in Chemicals and Related Products


Million Dollars
Imports
Excess of imports over exports
Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec
1926
1927
1928

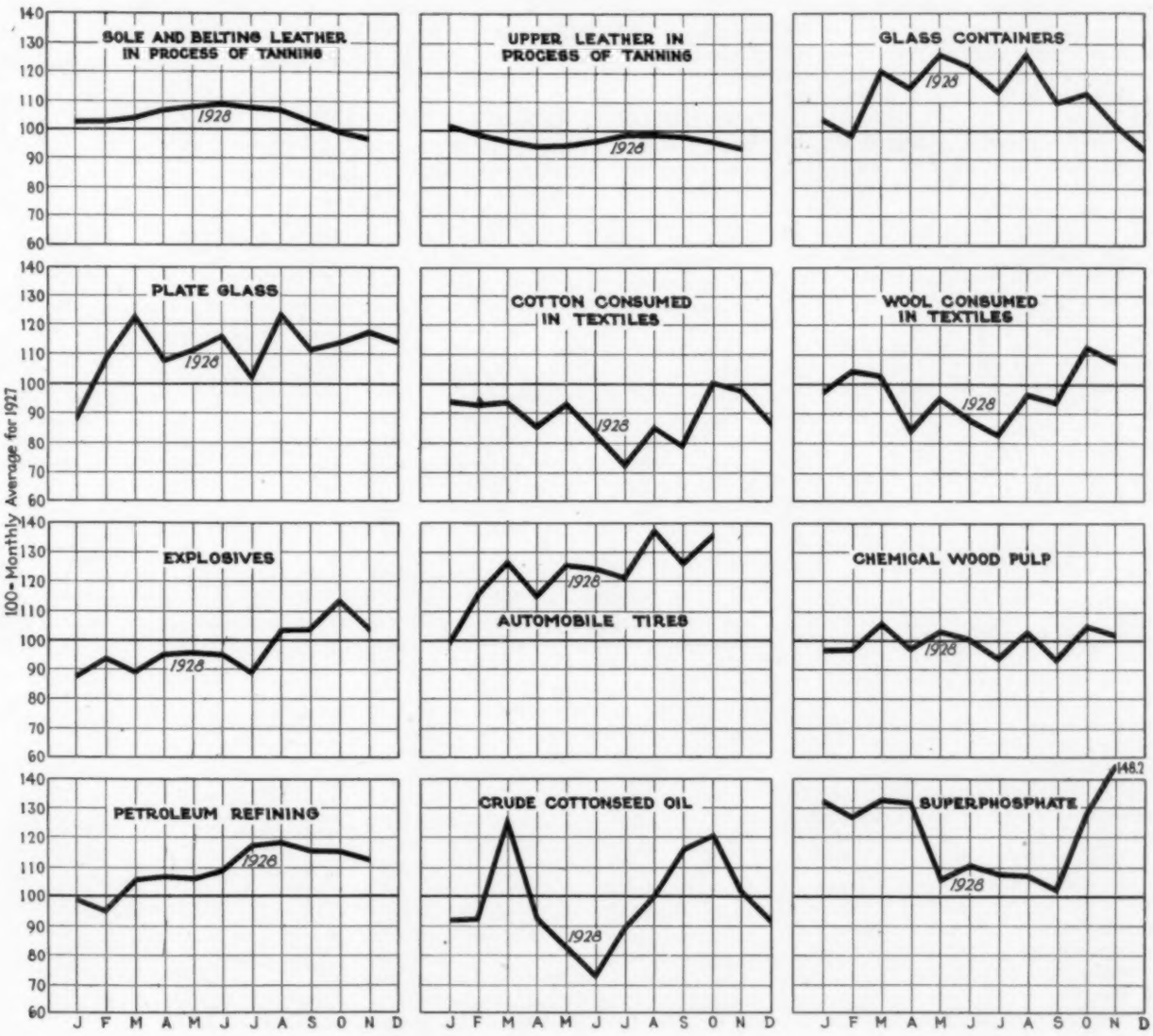


U. S. Department of Commerce



Productive activity based on electrical consumption—Electrical World

INDEXES OF ACTIVITY IN PRODUCING AND CONSUMING INDUSTRIES



Active Call for Contract Deliveries of Chemicals

Buying Operations in the Spot Market Also Reaches Large Proportions

THE increase in contract placements in the latter part of last year has resulted in a corresponding gain in shipping directions issued during the month by contract holders. In consequence, there has been an active movement of chemicals against existing orders. Trading in the spot market, likewise has been increasing since the turn of the year and total tonnage delivered to consuming industries for the year to date is reported to have exceeded deliveries for the corresponding period of last year.

While certain chemicals, notably the metal salts, have been influenced by higher costs for raw materials, the market in general has been marked by a steadiness in values which will probably be more than temporary in view of the fact that a large part of production has been sold ahead and surplus stocks are not expected to be large, at least in the near future.

Seasonal demand is reported for the various coal-tar chemicals with very little variation in quoted prices. Producers of toluol have been offering a little more freely than was the case in the last quarter of 1928 but production is still well sold ahead and spot offerings are by no means plentiful so the quoted values are partly nominal.

Of importance to soap manufacturers is the report that whale oil production in the South Seas, so far this season has far exceeded expectations. Up to the first of this year, Norwegian whalers had produced 650,000 bbl. of oil, compared with 425,000 bbl. in the corresponding period of the preceding season. In 1928, domestic imports of whale oil amounted to 9,118,067 gal. as against 8,768,156 gal. in 1927.

FALLING off in production of salt cake has been important as a market factor. The large stocks which were on hand early last year and which resulted in establishing very low sales prices, have now been worked off and offerings are relatively small. Under these conditions the market has shown a strong tone and prevailing prices are considerably above those which ruled a few months ago. The price trend is still upward. The fact that importations of salt cake were unusually large in 1928 brings up the question of probable competition from abroad in the present year. Germany is the principle source of supply for importations of salt cake and present conditions in domestic markets are regarded as favoring larger arrivals from Europe. A report from our trade commissioner in Germany recently stated that production of sodium sulphate in that country was introduced to utilize a part of the large quantities of waste magnesium sulphate (associated with potash production) which had formerly been dumped into German rivers. This source of cheap salt cake has enabled Germany to sell to the United States market in spite of the transportation cost involved. Preliminary estimates of production for 1928 are 280,000 tons, some 100,000 tons of which are exported principally to Scandinavia, Belgium, Italy, and The Netherlands. The 1928 estimates indicate that the United States took about one fifth of the total exports. This is a substantial increase over 1927 imports by the United States which were less than 8 per cent of the entire German exports.

CONSUMING demand for barium chloride has been expanding in recent years but domestic production has been held in check because of the keen competition which was encountered as a result of activities on the part of European producers. An application for an increase in the import duty, made in May, 1928, resulted in an investigation by the U. S. Tariff Commission and it has just been announced that a public hearing will be held on March 5. The investigation revealed that domestic consumption of barium chloride in 1926 was 12,730,758 lb., of which imported material offered 3,546,758 lb. with sales of the domestic material amounting to 9,184,000 lb. The chief use of barium chloride is in the manufacture of pigments for paints and lithographic inks.

In 1928, imports of barium chloride fell off in volume, the total for the first 11 months of the year being 2,223,128 lb. Shipments from Germany were materially reduced and amounted to only 342,217 lb. as compared with 1,367,682 lb. for the calendar year 1927. On the other hand imports from Belgium for the first 11 months of 1928 were 1,858,574 lb., as compared with 1,332,909 lb. for all of 1927. In 1927, total imports amounted to 3,154,853 lb. New York is the largest consuming center for barium chloride and of the amount imported in 1927, New York City consumed 61 per cent.

Shipments of sulphur are going forward in large volume with a slower export demand being offset by an increase in domestic requirements. A report from Canada states that a chemical company there is undertaking the extraction of sulphur from sulphide ores with the idea of supplying Canadian paper mills. Only experimental work has been undertaken thus far, using ores from one of the Aldermac bodies which contains about 50 per cent sulphur and 2 per cent copper. Large deposits of these sulphides are said to exist in the Abitibi and Rouyn mining districts, both of which offer comparatively short freight hauls to pulp mills at Iroquois Falls, Smooth Rock Falls and Kapuskasing.

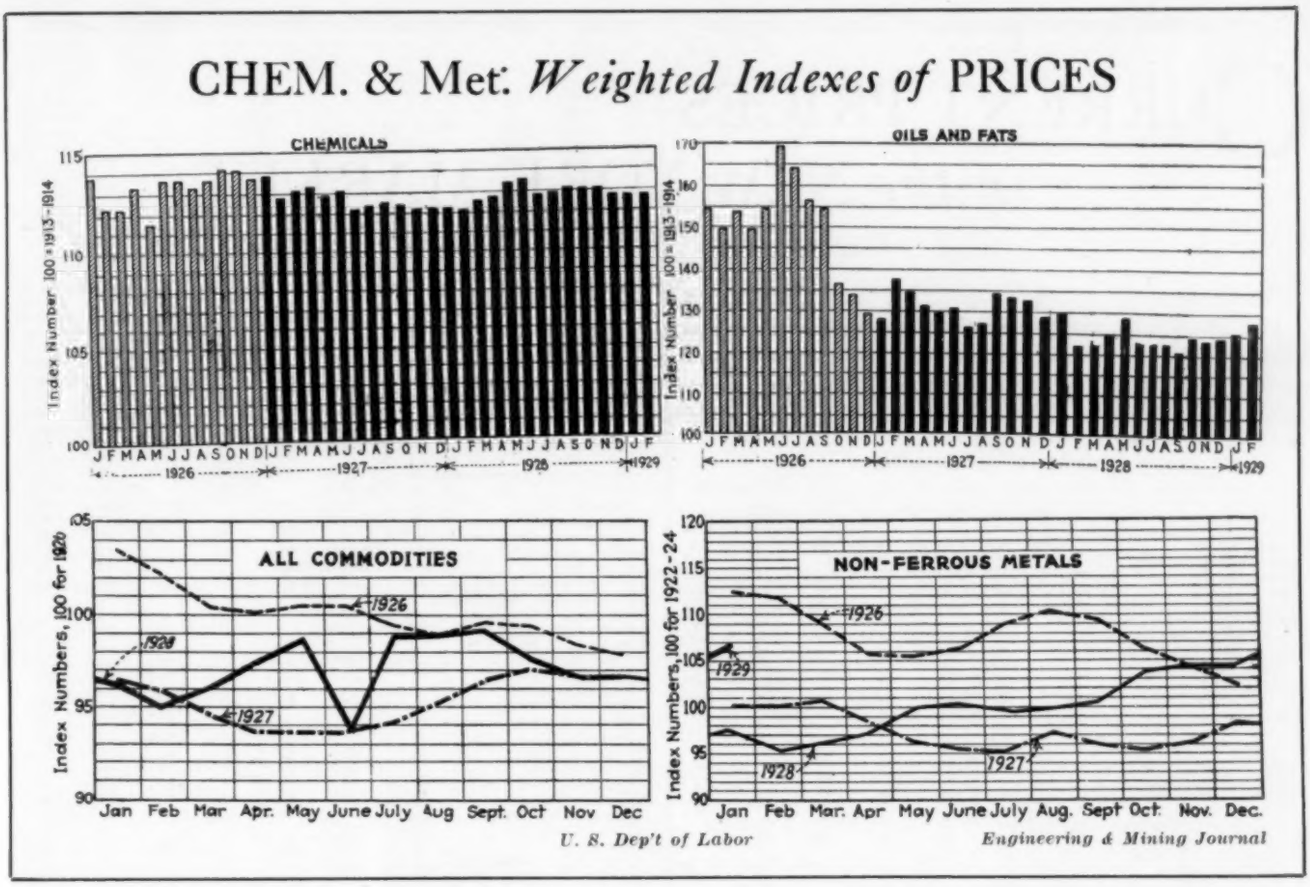
In view of the increase in world production of nitrate by air fixation it is interesting to note that the output of nitrate of soda in Chile not only is being maintained on a high plane but that plans are in formation to increase mining operations. Our commercial attaché at Santiago recently cabled that Chilean nitrate production established a record in 1928. The output reached a total of 3,163,000 metric tons which was 100,000 tons more than the 1917 output.

Exports of Chemicals

	Calendar Years 1927	1928
Benzol, gal.	25,793,566	21,338,429
Acid acetic, lb.	.....	298,333
Acid sulphuric, lb.	7,512,360	7,001,633
Acid boric, lb.	.....	3,382,183
Other acids, lb.	14,252,480	12,108,456
Methanol, gal.	311,272	528,015
Glycerin, lb.	693,144	2,051,937
Acetone, lb.	.....	4,959,104
Formaldehyde, lb.	2,235,960	2,368,086
Ammonium compounds, lb.	4,337,873	2,678,512
Aluminum sulphate, lb.	42,256,868	45,426,137
Acetate of lime, lb.	11,633,785	11,172,685
Calcium carbide, lb.	4,873,260	3,745,899
Bleaching, powder, lb.	16,686,586	21,869,528
Copper sulphate, lb.	6,206,904	8,666,899
Potassium compounds, lb.	3,930,269	16,328,312
Sodium bichromate, lb.	8,905,655	8,692,088
Sodium cyanide, lb.	1,299,416	1,579,447
Borax., lb.	73,907,981	135,702,837
Sodium carbonate, lb.	53,544,250	66,622,986
Sodium silicate, lb.	54,986,118	59,307,272
Caustic soda	100,888,637	119,414,865
Sodium bicarbonate, lb.	18,287,460	18711, 143
Other sodas, lb.	79,825,973	132,319,005
Sulphate of ammonia, ton.	138,692	93,010
Sulphur, ton.	789,274	685,268

Imports of Chemicals

	Calendar Years 1927	1928
Dead or creosote oil, gal.	95,915,221	88,385,074
Pyridine, lb.	135,692	54,616
Coal-tar acids, lb.	818,658	2,946,121
Coal-tar intermediates, lb.	1,768,010	1,444,755
Arsenic white, lb.	25,033,649	22,305,972
Acid, citric, lb.	116,704	63,834
Acid, formic, lb.	3,219,892	2,253,840
Acid oxalic, lb.	1,843,732	890,203
Acid sulphuric, lb.	34,868,874	26,327,631
Acid tartaric, lb.	2,854,035	1,913,016
Ammonium chloride, lb.	14,278,668	11,023,523
Ammonium nitrate, lb.	11,218,060	13,172,099
Barium compounds, lb.	14,648,841	14,877,162
Calcium carbide, lb.	4,450,726	2,527,215
Cobalt oxide, lb.	369,747	364,154
Copper sulphate, lb.	1,978,726	3,611,844
Bleaching powder, lb.	2,711,921	3,146,796
Glycerine crude, lb.	14,970,300	4,578,847
Glycerine, ref., lb.	8,268,071	4,230,627
Iodine, lb.	926,492	720,766
Magnesium compounds, lb.	21,053,681	17,308,996
Potassium cyanide, lb.	340,198	115,583
Potassium carbonate, lb.	13,192,395	16,912,432
Caustic potash, lb.	14,761,665	11,648,115
Cream of tartar, lb.	290,990	159,059
Potassium chlorate, lb.	13,391,603	13,129,760
Sodium cyanide, lb.	32,598,801	37,576,558
Sodium ferrocyanide, lb.	1,786,688	1,624,586
Sodium nitrite, lb.	291,726	107,739
Sodium nitrate, ton	748,782	1,032,911
Sulphate of ammonia, ton	17,153	42,066



Higher Metal Markets Affect Sales Prices for Salts

MANY chemicals which are produced from a metal base either have been advanced in price during the past month or have shown a firmer price tone which may eventuate in an upward revision of sales schedules. This condition has been a logical sequence of higher producing costs as represented by fairly general advances in the metal market.

Such basic chemicals as mineral acids and alkalies are strongly held not only because current quotations are in close harmony with producing costs but also due to the large volume of contract orders which producers are carrying. With a large part of this year's production sold ahead, spot offerings do not promise to be large and the possibility of price-cutting competition is thereby lessened.

Tariff revision lends some uncertainty to the future price position of some chemicals but it is too early to form an opinion regarding the scope of such changes. It is generally held, however, that revision of existing duties will not be drastic enough to cause any disturbance in the market.

At the beginning of 1928 ammonia liquor could not be disposed of readily in most parts of the United States. Hence, numerous coal-gas works were at that time planning to install facilities for conversion of liquor into sulphate. However, during the past year successful experiments have been conducted which permit the use of ammonia liquor for neutralizing acid phosphate under conditions that promise both low-cost ammoniated phosphate fertilizer and favorable prices for ammonia liquor.

By "favorable" prices for ammonia liquor one should not understand that the prices now obtainable are comparable with those prevailing in the prewar or early postwar years. During 1928 ammonia in the form of sulphate commanded approximately 8c. per lb. and there is no prospect that ammonia liquor prices will be any more favorable than this. With the pressure of intense competition between Chilean nitrate, which is being produced at an excessive rate, synthetic nitrogen compounds which are being manufactured in constantly growing amounts, and the by-product ammonia manufactured at slowly increasing rates as the coke industry increases in magnitude, there is prospect of further reduction in price rather than an increase, speaking in terms of trends over a period of years. Even the most venturesome hesitate to forecast how low nitrogen compounds will be before the price is stabilized.

THE price trend for vegetable oils and fats is upward at present. This condition will probably continue for the next few months. Tariff changes appear more important as price factors in the market for oils than in the case of chemicals. For instance, a large part of our flaxseed supply must be found outside this country and a higher import duty on this material undoubtedly would result in higher prices for linseed oil. Likewise, vegetable oils are imported in large volume and any change in their import status could hardly fail to become a factor on prices in domestic markets.

Chem. & Met. Weighted Index of Chemical Prices

Base = 100 for 1913-14

This month	**112.75**
Last month	112.69
February, 1928	112.11
February, 1927	112.79

Price changes in the list of chemical products were not important during the period. Basic chemicals have reached well established price levels and are not expected to fluctuate much in the near future. Lead pigments were higher following advances in the metal and the same was true for copper sulphate.

Chem. & Met. Weighted Index of Prices for Oils and Fats

Base = 100 for 1913-14

This month	**127.76**
Last month	126.44
February, 1928	122.02
February, 1927	137.14

Higher prices ruled for a majority of vegetable oils during the last month. Crude cottonseed oil led the advance and the refined market likewise reached higher levels. Olive oil foots advanced sharply and crude peanut oil showed decided firmness. Soya bean oil was lower.

CURRENT PRICES *in the* NEW YORK MARKET

For Chemicals, Oils and Allied Products

The following prices refer to round lots in the New York Market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to February 12.

Industrial Chemicals

		Current Price	Last Month	Last Year
Acetone, drums	lb.	$0.14 -$0.15	$0.14 -$0.15	$0.12 -$0.13
Acid, acetic, 28%, bbl.	cwt.	3.88 - 4.03	3.88 - 4.03	3.38 - 3.63
Boric, bbl.	lb.	.06½ - .07	.06½ - .07	.08½ - .08½
Citric, kegs	lb.	.46 - .47	.46 - .47	.45 - .47
Formic, bbl.	lb.	.11 - .12	.11 - .12	.11 - .12
Gallic, tech., bbl.	lb.	.50 - .55	.50 - .55	.50 - .55
Hydrofluoric 30% carb.	lb.	.06 - .07	.06 - .07	.06 - .07
Lactic, 44%, tech., light, bbl.	lb.	.12 - .12½	.12 - .12½	.13½ - .14
22%, tech., light, bbl.	lb.	.05½ - .06	.05½ - .06	.06½ - .07
Muriatic, 18°, tanks	cwt.	.85 - .90	.85 - .90	.85 - .90
Nitric, 36°, carboys	lb.	.05 - .05½	.05 - .05½	.05 - .05½
Oleum, tanks, wks.	ton	18.00 -20.00	18.00 -20.00	18.00- 20.00
Oxalic, crystals, bbl.	lb.	.11 - .11½	.11 - .11½	.11 - .11½
Phosphoric, tech., c'bys.	lb.	.08½ - .09	.08½ - .09	.08½ - .09
Sulphuric, 60°, tanks	ton	11.00 -11.50	11.00 -11.50	10.50 -11.00
Tannic, tech., bbl.	lb.	.35 - .40	.35 - .40	.35 - .40
Tartaric, powd., bbl.	lb.	.38 - .39	.38 - .39	.36 - .37
Tungstic, bbl.	lb.	1.00 - 1.20	1.00 - 1.20	1.00 - 1.20
Alcohol, ethyl, 190 p'f., bbl.	gal.	2.68½ - 2.71	2.68½ - 2.71	2.68½ - 2.71
Alcohol, Butyl, dr.	lb.	.18½ - .19	.18½ - .19	.19 - .20
Denatured, 190 proof				
No. 1 special dr.	gal.	.48 -	.48 -	.48 -
No. 5, 188 proof, dr.	gal.	.48 -	.48 -	.48 -
Alum, ammonia, lump, bbl.	lb.	.03½ - .04	.03½ - .04	.03½ - .04
Chrome, bbl.	lb.	.05½ - .05½	.05½ - .05½	.05½ - .06
Potash, lump, bbl.	lb.	.03 - .03½	.03 - .03½	.02½ - .03½
Aluminum sulphate, com., bags	cwt.	1.40 - 1.45	1.40 - 1.45	1.40 - 1.45
Iron free, bg.	cwt.	2.00 - 2.10	2.00 - 2.10	2.00 - 2.10
Aqua ammonia, 26°, drums	lb.	.03 - .04	.03 - .04	.03 - .04
Ammonia, anhydrous, cyl.	lb.	.13½ -	13½ -	.13 -
Ammonium carbonate, powd. tech., casks	lb.	.12 - .13	.12 - .13	.10½ - .14
Sulphate, wks.	cwt.	2.30 -	2.30 -	2.40 -
Amylacetate tech., drums	gal.	1.75 - 2.00	1.75 - 2.00	1.75 - 2.00
Antimony Oxide, bbl.	lb.	.10½ - .10½	.10½ - .10½	.15 - .16
Arsenic, white, powd., bbl.	lb.	.04 - .04½	.04 - .04½	.04 - .04½
Red, powd., kegs	lb.	.09 - .10	.09 - .10	.09½ - .10
Barium carbonate, bbl.	ton	57.50 -60.00	57.50 -60.00	50.00 - 52.00
Chloride, bbl.	ton	63.00 -70.00	63.00 -70.00	56.00 -58.00
Nitrate, cask	lb.	.07½ - .08	.07½ - .08	.08 - .08½
Blanc fixe, dry, bbl.	lb.	.03½ - .04	.03½ - .04	.04 - .04½
Bleaching powder, f.o.b., wks., drums	cwt.	2.00 - 2.10	2.00 - 2.10	2.00 - 2.10
Borax, bbl.	lb.	.02½ - .03	.02½ - .03	.04 - .04½
Bromine, cs.	lb.	.45 - .47	.45 - .47	.45 - .47
Calcium acetate, bags	cwt.	4.50 -	4.50 -	3.50 -
Arsenate, dr.	lb.	.06½ - .07	.06½ - .07	.07 - .08
Carbide drums	lb.	.05 - .06	.05 - .06	.05 - .06
Chloride, fused, dr., wks.	ton	20.00 -	20.00 -	21.00 -
Phosphate, bbl.	lb.	.08 - .08½	.08 - .08½	.07 - .07½
Carbon bisulphide, drums	lb.	.05 - .06	.05 - .06	.05½ - .06
Tetrachloride drums	lb.	.06½ - .07	.06½ - .07	.06½ - .07
Chlorine, liquid, tanks, wks.	lb.	.03 - .03½	.03 - .03½	.03½ - .04½
Cylinders	lb.	.05 - .08	.05 - .08	.05½ - .08
Cobalt oxide, cans	lb.	2.10 - 2.20	2.10 - 2.20	2.10 - 2.25
Copperas, bgs., f.o.b. wks.	ton	16.00 - 17.00	16.00 - 17.00	14.00 - 17.00
Copper carbonate, bbl.	lb.	.17 - .17½	.17 - .17½	.17 - .17½
Cyanide, tech., bbl.	lb.	.49 - .50	.49 - .50	.49 - .50
Sulphate, bbl.	cwt.	5.65 - 5.75	5.50 - 5.70	5.00 - 5.10
Cream of tartar, bbl.	lb.	.27½ - .28	.27½ - .28	.25½ - .27
Diethylene glycol, dr.	lb.	.10 - .15	.10 - .15	.15 - .20
Epsom salt, dom., tech., bbl.	cwt.	1.75 - 2.15	1.75 - 2.00	1.75 - 2.00
Imp., tech., bags	cwt.	1.15 - 1.25	1.15 - 1.25	1.15 - 1.25
Ethyl acetate, drums	gal.	1.03 -	1.03 -	.83 -
Formaldehyde, 40%, bbl.	lb.	.09½ - .10	.09½ - .10	.08½ - .09
Furfural, dr.	lb.	.15 - .17½	.15 - .17½	.15 - .17
Fusel oil, crude, drums	gal.	1.30 - 1.40	1.30 - 1.40	1.30 - 1.40
Refined, dr.	gal.	1.90 - 2.00	1.90 - 2.00	2.50 - 3.00
Glaubers salt, bags	cwt.	1.10 - 1.20	1.10 - 1.20	1.00 - 1.10
Glycerine, e.p., drums, extra	lb.	.14 - .15	.14 - .15	.21½ - .22
Lead:				
White, basic carbonate, dry, casks	lb.	.08½ -	.08½ -	.08½ -
White, basic sulphate, sck.	lb.	.07½ -	.07½ -	.08 -
Red, dry, sck.	lb.	.10 -	.09½ -	.10 -
Lead acetate, white crys., bbl.	lb.	.14 - .14½	.13 - .13½	.13 - .13½
Lead arsenate, powd., bbl.	lb.	.13 - .14	.13 - .14	.12 - .13
Lime, chem., bulk	ton	8.50 -	8.50 -	8.50 -
Litharge, pwd., csk.	lb.	.09 -	.08½ -	.09 -
Lithopone, bags	lb.	.05½ - .06	.05½ - .06	.05½ - .06½
Magnesium carb., tech., bags	lb.	.06 - .06½	.06½ - .07	.07½ - .08
Methanol, 95%, dr.	gal.	.55 -	.55 -	.53 -
97%, dr.	gal.	.55 -	.55 -	.55 -
Nickel salt, double, bbl.	lb.	.13 - .13½	.10 - .10½	.10 - .10
Single, bbl.	lb.	.13 - .13½	.10½ - .11	.10½ - .11½
Orange mineral, csk.	lb.	$0.12 -	$0.11½ -	$0.12 -
Phosphorus, red, cases	lb.	.55 - .57	.62 - .65	.62 - .65
Yellow, cases	lb.	.32 - .33	.32 - .34	.32 - .33
Potassium bichromate, casks	lb.	.08½ - .08½	.08½ - .08½	.08½ - .08½
Carbonate, 80-85%, calc., csk.	lb	.05½ - .06	.05½ - .06	.05½ - 06
Chlorate, powd.	lb.	.07½ - .08½	.07½ - .08½	.08½ - .09
Cyanide, cs.	lb.	.52 - .55	.52 - .55	55 - .57
First sorts, csk.	lb.	.08½ - .09	.08½ - .09	.08½ - .09
Hydroxide(c'stic potash)	dr. lb.	.07½ - .07¾	.07½ - .07¾	.07½ - .07½
Muriate, 80% bgs.	ton	36.40 -	36.40 -	36.40 -
Nitrate, bbl.	lb.	.06 - .06½	.06 - .06½	.06 - .07½
Permanganate, drums	lb.	.16 - .16½	.16 - .16½	.15 - .16
Prussiate, yellow, casks	lb.	.19 - .19½	.19 - .19½	.18 - .19
Sal ammoniac, white, casks	lb.	.046 - 05	.047 - .05	.05 - .05½
Salsoda, bbl.	cwt.	.90 - .95	.90 - .95	.90 - .95
Salt cake, bulk	ton	16.00 -18.00	15.00 -17.00	17.00 - 19.00
Soda ash, light, 58%, bags, contract	cwt.	1.32 -	1.32 -	1.32 -
Dense, bags	cwt.	1.35 -	1.35 -	1.35 -
Soda, caustic, 76%, solid, drums, contract	cwt.	2.80 - 3.00	2.80 - 3.00	.00 - 3.10
Acetate, works, bbl.	lb.	.05 - .05½	.05½ - .06½	.04½ - .05
Bicarbonate, bbl.	cwt.	2.00 - 2.25	2.00 - 2.25	2.00 - 2.25
Bichromate, casks	lb.	.07 - .07½	.07 - .07½	.06½ - .06½
Bisulphate, bulk	ton	12.00 -15.00	12.00 -15.00	3.00 - 3.50
Bisulphite, bbl.	lb.	.03½ - .03¾	.03½ - .03¾	.03½ - .04
Chlorate, kegs	lb.	.06½ - .07	.06½ - .07	.06½ - .06½
Chloride, tech.	ton	12.00 -14.75	12.00 -14.75	12.00 -14.00
Cyanide, cases, dom.	lb.	.18 - .22	.18 - .22	.18 - .22
Fluoride, bbl.	lb.	.08½ - .09½	.08½ - .09½	.08½ - .09
Hyposulphite, bbl.	lb.	2.50 - 3.00	2.50 - 3.00	2.50 - 3.00
Nitrate, bags	cwt.	2.15 -	2.15 -	2.40 -
Nitrite, casks	lb.	.07½ - .08	.07½ - .08	.08 - .08½
Phosphate, dibasic, bbl.	lb.	.03½ - .03¾	.03 - .03¾	.03½ - .03½
Prussiate, yel. drums	lb.	.11½ - .12	.11½ - .12	.12 - .12½
Silicate (30°, drums)	cwt.	.75 - 1.15	.75 - 1.15	.75 - 1.15
Sulphide, fused, 60-62%, dr.	lb.	.02½ - .03¼	.02½ - .03	.03½ - .04
Sulphite, crys., bbl.	lb.	.02½ - .03	.02½ - .03	.02½ - .03
Strontium nitrate, bbl.	lb.	.09 - .09½	.09 - .09½	.09 - .09½
Sulphur, crude at mine, bulk	ton	18.00 -	18.00 -	18.00 -
Chloride, dr.	lb.	.04 - .05	.04 - .05	.05 - .05½
Dioxide, cyl.	lb.	.09 - .10	.09 - .10	.09 - .10
Flour, bag	cwt.	1.55 - 3.00	1.55 - 3.00	1.55 - 3.00
Tin bichloride, bbl.	lb.	.15½ -	.15½ -	.17½ -
Oxide, bbl.	lb.	.54 -	.54 -	.62 -
Crystals, bbl.	lb.	.37 -	.37½ -	.41 -
Zinc chloride, gran., bbl.	lb.	.06½ - .06½	.06½ - .06½	.06½ - .06½
Carbonate, bbl.	lb.	.10 - .11	.10 - .10½	.10 - .11
Cyanide, dr.	lb.	.40 - .41	.40 - .41	.40 - .41
Dust, bbl.	lb.	.08½ - .09	.08½ - .09	.09 - .10
Zinc oxide, lead free, bag.	lb.	.06½ -	.06½ -	.06½ -
5% lead sulphate, bags	lb.	.06½ -	.06½ -	.06½ -
Sulphate, bbl.	cwt.	2.75 - 3.00	2.75 - 3.00	2.75 - 3.00

Oils and Fats

		Current Price	Last Month	Last Year
Castor oil, No. 3, bbl.	lb.	$0.12½ -$0.13	$0.12½ -$0.13	$0.13 -$0.13½
Chinawood oil, bbl.	lb.	.15 -	.14½ -	.18 -
Coconut oil, Ceylon, tanks, N. Y.	lb.	.08½ -	.08½ -	.08½ -
Corn oil crude, tanks, (f.o.b. mill)	lb.	.09½ -	.08½ -	.09½ -
Cottonseed oil, crude (f.o.b. mill), tanks	lb.	.09 -	.08½ -	.08½ -
Linseed oil, raw, car lots, bbl.	lb.	.102 -	.10 -	.098 -
Palm, Lagos, casks	lb.	.09 -	.09 -	.08 -
Niger, casks	lb.	.08½ -	.08½ -	.07½ -
Palm Kernel, bbl.	lb.	.09½ -	.09½ -	.09 -
Peanut oil, crude, tanks (mill)	lb.	.10½ -	.10 -	.09½ -
Rapeseed oil, refined, bbl.	gal.	.83 - .85	.82 - .84	.82 - .84
Soya bean tank (f.o.b. Coast)	lb.	.09½ -	.10 -	.09½ -
Sulphur (olive foots), bbl.	lb.	.11½ -	.10½ -	.10 -
Cod, Newfoundland, bbl.	gal.	.65 - .67	.65 - .67	.63 - .65
Menhaden, light pressed, bbl.	gal.	.62 - .63	.60 - .61	.60 - .62
Crude, tanks (f.o.b. factory)	gal	.48 -	.48 -	.44 -
Whale, crude, tanks	gal.	.80 -	.78 -	-
Grease, yellow, loose	lb.	.07½ -	.07½ -	.07½ -
Oleo stearine	lb.	.10½ -	.10½ -	.10½ -
Red oil, distilled, d.p. bbl.	lb.	.09½ - .10	.09½ - .09½	.09½ - .09½
Tallow, extra, loose	lb.	.09½ -	.09½ -	.08½ -

Coal-Tar Products

		Current Price	Last Month	Last Year
Alpha-naphthol, crude, bbl.	lb.	$0.60 -$0.65	$0.60 -$0.65	$0.60 -$0.62
Refined, bbl.	lb.	.80 - .85	.80 - .85	.85 - .90
Alpha-naphthylamine, bbl.	lb.	.32 - .34	.32 - .34	.35 - .36
Aniline oil, drums, extra	lb.	.14½ - .15	.14½ - .15	.15 - .16
Aniline salts, bbl.	lb.	.24 - .25	.24 - .25	.24 - .25
Anthracene, 80%, drums	lb.	.60 - .65	.60 - .65	.60 - .65

Coal Tar Products (Continued)

		Current Price	Last Month	Last Year
Benzaldehyde, U.S.P., dr.	lb.	1.15 - 1.25	1.15 - 1.35	1.15 - 1.25
Benzidine base, bbl.	lb.	.67 - .70	.65 - .70	.70 - .72
Benzoic acid, U.S.P., kgs.	lb.	.57 - .60	.57 - .60	.58 - .60
Benzyl chloride, tech, dr.	lb.	.25 - .26	.25 - .26	.25 - .26
Benzol, 90%, tanks, works	gal.	.23 - .25	.23 - .25	.24 - .25
Beta-naphthol, tech., drums	lb.	.22 - .24	.22 - .24	.22 - .24
Cresol, U.S.P., dr.	lb.	.14 - .17	.14 - .17	.18 - .20
Cresylic acid, 97%, dr., wks	gal.	.73 - .75	.73 - .75	.61 - .62
Diethylaniline, dr.	lb.	.55 - .58	.55 - .58	.58 - .60
Dinitrophenol, bbl.	lb.	.30 - .32	.30 - .31	.31 - .35
Dinitrotoluen, bbl.	lb.	.17 - .18	.17 - .18	.17 - .18
Dip oil, 25% dr.	gal.	.26 - .28	.28 - .30	.28 - .30
Diphenylamine, bbl.	lb.	.42 - .43	.43 - .45	.45 - .47
H-acid, bbl.	lb.	.60 - .63	.60 - .63	.63 - .65
Naphthalene, flake, bbl.	lb.	.04½- .05	.05 - .06	.04½- .05
Nitrobenzene, dr.	lb.	.09 - .10	.09 - .10	.09 - .10
Para-nitraniline, bbl.	lb.	.55 - .56	.55 - .56	.52 - .53
Para-nitrotoluine, bbl.	lb.	.29 - .31	.28 - .32	.28 - .32
Phenol, U.S.P., drums	lb.	.13½- .14	.13 - .14	.18 - .19
Picric acid, bbl.	lb.	.30 - .40	.30 - .40	.30 - .40
Pyridine, dr.	lb.	1.75 - 1.90	1.75 - 1.90	3.00 -.....
R-salt, bbl.	lb.	.44 - .45	.44 - .45	.47 - .50
Resorcinal, tech, kegs.	lb.	1.30 - 1.35	1.30 - 1.35	1.30 - 1.40
Salicylic acid, tech., bbl.	lb.	.30 - .32	.30 - .32	.30 - .32
Solvent naphtha, w.w.,tanks	gal.	.30 - .35	.30 -.....	.35 -.....
Tolidine, bbl.	lb.	.86 - .90	.86 - .90	.95 - .96
Toluene, tanks, works	gal.	.45 -	.40 -	.35 -
Xylene, com., tanks	gal.	.30 - .40	.30 - .35	.36 - .40

Miscellaneous

		Current Price	Last Month	Last Year
Barytes, grd., white, bbl.	ton	$23.00-$25.00	$23.00-$25.00	$23.00-$25.00
Casein, tech., bbl.	lb.	.16½ .17	.15 - .16	.17½- .18
China clay, dom.,f.o.b. mine	ton	10.00 -20.00	10.00 -20.00	10.00 -20.00
Dry colors:				
Carbon gas, black (wks.)	lb.	.08 - .13	.07½- .08	.06½- .07
Prussian blue, bbl	lb.	.32 - .33	.31 - .33	.33 - .34
Ultramine blue, bbl.	lb.	.06 - .32	.08 - .35	.08 - .35
Chrome green, bbl.	lb.	.30 - .32	.27 - .30	.27 - .30
Carmine red, tins	lb.	6.00 - 6.50	5.25 - 5.50	5.50 - 5.75
Para toner	lb.	.70 - .75	.60 - .70	.80 - .90
Vermilion, English, bbl.	lb.	1.90 - 2.00	1.80 - 1.85	1.80 - 1.85
Chrome yellow, C. P., bbl.	lb.	.16 - .16½	.15½- .16	.17 - .18
Feldspar, No. 1 (f.o.b. N. C.)	ton	5.75 - 7.00	5.75 - 7.00	5.75 - 7.00
Graphite, Ceylon, lump, bbl	lb.	.08 - .08½	.08 - .08½	.08 - .09
Gum copal, Congo, bags.	lb.	.07¼- .08	.07¼- .08	.07¼- .08½
Manila, bags.	lb.	.16 - .17	.15 - .16	.15 - .18
Damar, Batavia, cases	lb.	.24 - .25	.22 - .23	.25 - .25
Kauri, No. 1 cases	lb.	.48 - .53	.48 - .53	.48 - .53
Kieselguhr (f.o.b. N. Y.)	ton	50.00 -55.00	50.00 -55.00	50.00 -55.00
Magnesite, calc.	ton	40.00 -.....	40.00 -.....	44.00 -.....
Pumice stone, lump, bbl.	lb.	.05 - .07	.05 - .08	.05 - .07
Imported, casks	lb.	.03 - .40	.03 - .40	.03 - .35
Rosin, H.	bbl.	9.50 -.....	9.50 -.....	10.30 -.....
Turpentine	gal.	.59 -.....	.59 -.....	.63 -.....
Shellac, orange, fine, bags	lb.	.61 -.....	.61 -.....	.56 - .59
Bleached, bonedry, bags	lb.	.56 - .60	.56 - .58	.59 - .61
T. N. bags	lb.	.43 - .44	.46 - .47	.52 - .54
Soapstone (f.o.b. Vt.), bags	ton	10.00 -12.00	10.00 -12.00	10.00 -12.00
Talc, 200 mesh (f.o.b. Vt.)	ton	9.50 -.....	9.50 -.....	10.50 -.....
300 mesh (f.o.b. Ga.)	ton	7.50 -10.00	7.50 -10.00	7.50 -11.00
225 mesh (f.o.b. N. Y.)	ton	13.75 -.....	13.75 -.....	13.75 -.....
Wax, Bayberry, bbl.	lb.	$0.30 -$0.32	$0.31 -$0.32	$0.24 -$0 26
Beeswax, ref., light	lb.	.41 - .42	.41 - .42	.43 - .45
Candelilla, bags	lb.	.22 - .23	.23 - .24	.27 - .28
Carnauba, No. 1, bags	lb.	.40 - .41	.46 - .48	.55 - .60
Paraffine, crude 105-110 m.p.	lb	.04¾- .05	.04¾- .05	.05¼- .06

Ferro-Alloys

		Current Price	Last Month	Last Year
Ferrotitanium, 15-18%	ton	$200.00-.....	$200.00-.....	$200.00-.....
Ferromanganese, 78-82%	ton	105.00-.....	105.00-.....	100.00-.....
Spiegeleisen, 19-21%	ton	33.00-.....	32.00-.....	30.00-32.00
Ferrosilicon, 14-17%	ton	45.00-.....	45.00-.....	33.00-38.00
Ferrotungsten, 70-80%	lb.	1.04- 1.10	.95- .98	.95- .98
Ferro-uranium, 35-50%	lb.	4.50-.....	4.50-.....	4.50-.....
Ferrovanadium, 30-40%	lb.	3.15- 3.75	3.15- 3.75	3.15- 3.75

Non-Ferrous Metals

		Current Price	Last Month	Last Year
Copper, electrolytic	lb.	$0.16¾-.....	$0.16¾ -.....	$0.13½-.....
Aluminum, 96-99%	lb.	.24 - .26	.24 - .26	.25 - .26
Antimony, Chin. and Jap.	lb.	.09¾-.....	11½-.....	.10¾-.....
Nickel, 99%	lb.	.35 -.....	.35 -.....	.35 -.....
Monel metal, blocks	lb.	.28 -.....	.28 - .28	.32 - .33
Tin, 5-ton lots, Straits	lb.	.49 -.....	.49 -.....	.58¼-.....
Lead, New York, spot	lb.	6.75 -.....	6.50 -.....	6.50 -.....
Zinc, New York, spot	lb.	6.70 -.....	6.70 -.....	6.15 -.....
Silver, commercial	oz.	.56¾-.....	.57½-.....	.57¾-.....
Cadmium	lb.	.85 - .95	.85 - .95	60 -.....
Bismuth, ton lots	lb.	1.70 -.....	1.70 -.....	1.85 - 2.10
Cobalt	lb.	2.10 - 2.50	2.10 - 2.50	2.50 -.....
Magnesium, ingots, 99%	lb.	.85 - 1.10	.85 - 1.10	.75 - .80
Platinum, ref.	oz.	70.00- 72.50	70 00- 72.50	72.00 -.....
Palladium, ref.	oz.	38.00- 40.00	42 00- 46.00	50.00-52.00
Mercury, flask	75 lb.	118.00-.....	122.00-	128.00-.....
Tungsten powder	lb.	1.10- 1.15	1.10- 1.15	1.05-.....

Ores and Semi-finished Products

		Current Price	Last Month	Last Year
Bauxite, crushed, wks.	ton	$7.50- $8.00	$7.50- $8.50	$5.50- $8.75
Chrome ore, c.f. post.	ton	22.00- 25.00	22.00- 24.00	22.00- 23.00
Coke, fdry., f.o.b. ovens	ton	2 85- 3 00	2 85- 3 00	3.25- 3.75
Fluorspar, gravel, f.o.b. Ill.	ton	18 00- 20.00	17.00- 18.00	17.00-.....
Ilmenite, 52% TiO_2, Va.	lb.	.00¾ .00¾	.00¾- .00¾	.00¾-.....
Manganese ore, 50% Mn., c.i.f. Atlantic Ports	unit	.34 - .37	.36 - .38	.36 - .38
Molybdenite, 85% MoS_2 per lb. MoS_2, N. Y.	lb.	.48 - .50	.48 - .50	.48- .50
Monazite, 6% of ThO_2	ton	130.00-.....	130.00-.....	120.00-.....
Pyrites, Span. fines, c.i.f.	unit	.13 -.....	.13 -.....	.13½-.....
Rutile, 94-96% TiO_2	lb.	.11 - .13	.11 - .13	.11 - .13
Tungsten, scheelite, 60% WO_3 and over	unit	11.25 -11.50	11.25 -11.50	11.25 -11.50
Vanadium ore, per lb. V_2O_5	lb.	.28	nom.	.25 - .28
Zircon, 99%	lb.	.03 -.....	.03 -.....	.03 -.....

CURRENT INDUSTRIAL DEVELOPMENTS

New Construction and Machinery Requirements

Aluminum Factory—United States Aluminum Co., R. L. Streeter, V. Pres., Oliver ., Pittsburgh, Pa., plans the construction of a 100 x 900 ft. rolling mill for the facture of aluminum alloys at Alcoa, Estimated cost to exceed $1,000,000.

Ammunition Depot—Bureau of Yards & ks, Navy Dept., Washington, D. C., ans remodeling buildings at Naval Ammunition Depot, St. Juliens Creek, Va.

Blast Furnace and By-Product Ovens—Wierton Steel Co., Wierton, W. Va., is having plans prepared for the construction of a blast furnace and by-product ovens. Estimated cost $10,000,000. Private plans.

Briquetting Plant Addition—Lehigh Briquetting Co., Lehigh, N. D., plans addition to plant including five additional carbonizers. Estimated cost $400,000. R. W. Richardson, 301 Zenith Bldg., St. Paul, Minn., is engineer.

Bronze Factory—Johnson Bronze Co., New Castle, Pa., awarded contract for the construction of two 2 story, 85 x 152 and 120 x 158 ft. factory buildings to Hawkins Downie Co., 630 Market St., Youngstown, O. Estimated cost $100,000.

Celotex Plant—Celotex Co., 645 North Michigan Ave., Chicago, Ill., will soon award contract for addition to celotex plant at Marrero, La. Estimated cost $500,000.

Cement Plant—Hercules Portland Cement Co., Washington St. and 4th Ave., Los Angeles, Calif., plans the construction of a cement plant to include, crushing plant, grinding mill, silos, packing plant, machine shop, storage building, kilns, etc. at Torrance, Calif. Estimated cost to exceed $1,000,000. Private plans.

Cement Plant—Standard Slag Co., c/o Jones & Laughlin, Ross St., Pittsburgh, Pa., plans the construction of a plant to utilize slag from blast furnaces in cement production. Estimated cost $500,000.

Chemical Factory — American Agricultural Chemical Co., Searsport, Me., plans the reconstruction of three factory buildings recently destroyed by fire. Architect not selected. Work will be done by day labor.

Chemical Plant—Hooker Electrochemical Co., E. H. Hooker, Pres., 25 Pine St., New York, N. Y., plans the construction of a plant for the manufacture of caustic soda in various forms, liquid chlorine, bleaching powder, muriatic acid, benzoates, etc., at Tacoma, Wash. Estimated cost $250,000.

Chemical Plant—U. S. Chemical Co., J. C. Culbert, 408 Mill St., Central Falls, R. I., plans the construction of a plant at Pawtucket. Estimated cost to exceed $40,000. Architect not selected.

Chemical Plant—A. L. Van Ameringen, 451 South Jefferson St., Orange, N. J., is receiving bids for the construction of a 1 story, 75 x 150 ft. chemical plant at Mountain View. Estimated cost $40,000. H. F. Clark, 38 Clinton St., Newark, is architect.

Chemical Plant—W. A. Webster Chemical Co., 224 East St., Memphis, Tenn., awarded contract for the construction of a chemical plant at East St. and Eastmoreland Ave. to S. Malkin & Co., 474 North Manassas St., Memphis. Estimated cost $40,000.

Chemicals — City Council, Toledo, O., authorized the purchase of chemicals for waterworks. Estimated cost $10,000.

Chemistry Equipment—A. & M. College, R. D. Marburger, Buildings and College Utilities, College Station, Tex., is receiving bids for equipment for proposed chemistry building.

Chemicals — General Supply Committee, Bldg. F, 6th and B Sts., N. W., Washington, D. C., will receive bids until Mar. 2 for chemicals to include drugs, medicines, gases and glycerine, also laboratory apparatus, etc.

Chlorinating Apparatus—Bureau of Yards & Docks, Navy Dept., Washington, D. C., plans the installation of chlorinating apparatus and accessories for Naval Academy, Annapolis, Md.

Chrome Nickel Plant—Sterling Brass Co., S. L. Weil, Pres., 9600 St. Catherine Ave., Cleveland, O., plans the construction of a chrome nickel plant at East 96th St. and St. Catherine Ave. Estimated cost $60,000. Architect not selected.

Clay Products Plant—South Beaver Clay Products Co., Beaver Falls, Pa., plans the construction of a clay products plant at Negley, Pa. Estimated cost $100,000.

Cleansing Products Plant — Hygienic Products Co., 709 Walnut Ave., Canton, O., plans the construction of a cleansing products plant on Walnut Ave. N. E. Estimated cost $50,000. Lockwood Greene &

Co., Hanna Bldg., Cleveland, O., are engineers.

Dry Color Factory — J. H. Hall, Cucamonga, Calif., representing Western Metallic Dry Color Co., plans the construction of a 2 and 3 story, 60 x 120 ft. factory at Upland, Calif.

Foundry and Enameling Plant, etc. — Rundle Mfg. Co., 27th St. and Cleveland Ave., Milwaukee, Wis., had plans prepared for the construction of a 150 x 330 ft. foundry, 100 x 180 ft. enameling plant, 100 x 140 ft. casting cleaning building, 130 x 180 ft. warehouse and shipping building, power house, etc. at Camden, N. J. Estimated cost $1,000,000. A. A. Wickland & Co., 205 West Wacker Dr., Chicago, Ill., are architects.

Gas Generating Plant—Jersey Central Power & Light Co., 20 South St., Morristown, N. J., plans the construction of a gas generating plant at Montville. Estimated cost $40,000. Architect not selected.

Gas Plant—Missouri Natural Gas Co., H. H. Dodd, Mgr., Dubuque, Ia., awarded contract for the construction of a gas plant at Poplar Bluff, Mo., to Management & Engineering Corp., 327 South La Salle St., Chicago, Ill. Estimated cost $200,000.

Gas, Plant Addition — Illinois Power & Light Corp., 231 South La Salle St., Chicago, Ill., will build a 30 x 30 ft. addition to gas plant at Decatur. Estimated cost $110,000. Private plans. Work will be done by owners forces. Contract let for carbureted water gas set.

Gasoline Plant—Indian Territory Illuminating Oil Co., Bartlesville, Okla., plans the construction of a casinghead gasoline plant, on Bodine lease near Bartlesville. 7,000 gal. capacity. Estimated cost $100,000. Private plans.

Glass Plant — Hazel Atlas Glass Co., Wheeling, W. Va., is receiving bids for the construction of a 4 story, 60 x 100 ft. warehouse for glass plant at Washington, Pa. Estimated cost $150,000. Private plans.

Glass Factory—Libby-Owen Glass Co., Nicholas Bldg., Toledo, O., awarded contract for the construction of a factory on East Toledo St. to A. Bentley & Sons, Belmont St., Toledo. Estimated cost $4,000,000.

Glass Factory Addition—American Window Glass Co., Farmers Bank Bldg., Pittsburgh, Pa., awarded contract for a 1 story addition to glass factory at Arnold, Pa., to Heyl & Patterson, Water St., Pittsburgh. Estimated cost $100,000.

Kodak Plant—Eastman Kodak Co., 343 State St., Rochester, N. Y., awarded contract for addition to plant to Ridge Construction Co., 335 Lewiston Ave., Rochester. Estimated cost $200,000.

Laboratory—Bd. of Higher Education, M. J. Stroock, Chn., 736 Riverside Dr., New York, N. Y., plans the construction of a 4 story, 130 x 213 ft. laboratory at Navy Ave. and Bedford St. Estimated cost $1,000,000. Thompson, Holmes & Converse and C. B. Meyers, 101 Park Ave., New York, are architects.

Laboratory—Celenese Corp. of America, Cumberland, Md., awarded contract for the construction of a 2 story, 88 x 145 ft. laboratory to G. Hazelwood Co., Dexter St., Cumberland. Estimated cost $200,000.

Laboratory—Port of New York Authority, 75 West St., New York, N. Y., awarded contract for a 2 story, 52 x 100 ft. laboratory at Westside Ave. and Fox Pl., Jersey City, N. J., to Oscher Engineering & Contracting Co., 1457 Broadway, New York, N. Y. Estimated cost $250,000.

Laboratory—Constructing Quartermaster, Army Medical Center, Washington, D. C., awarded contract for additional buildings and laboratory for Walter Reed Hospital, to Virginia Engineering Co., First National Bank Bldg., Newport News, Va. Estimated cost $1,056,765.

Laboratory—Queen City Dental Manufacturers, 112½ Carlton St., Toronto, Ont., is having plans prepared for the construction of a 2 story laboratory and factory on Hayden St. Estimated cost $50,000. R. Card, 142 Chester Ave., Toronto, is architect.

Laboratory Addition — Western Reserve University, R. E. Vinson, Pres., 10940 Euclid Ave., Cleveland, O., will soon award contract for 4 story, 55 x 80 ft. addition to laboratory. Estimated cost $175,000. C. W. Hopkinson, Rose Bldg., Cleveland, Archt.

Lead Smelter Plant—Eagle-Picher Lead Co., Joplin, Mo., is having plans prepared for addition to lead smelter plant at Ontario, Okla. Estimated cost $75,000. Private plans.

Leather Factory — Dorrington Leather Co., 175 Main St., Woburn, Mass., plans the reconstruction of factory recently destroyed by fire. Architest not selected.

Linoleum and Cork Products Manufacturing Plant—Armstrong Cork Co., C. D. Armstrong Jr., Allegheny, River and 24th St., Pittsburgh, Pa., is having plans prepared for the construction of linoleum, cork products manufacturing plant. Estimated cost $1,000,000. Private plans.

Linseed Oil Plant Equipment—Dominion Linseed Oil Co., Owensound, Ont., prices and catalogs on complete new machinery for plant recently destroyed by fire.

Liquer Blending Plant—Monarch Liquers Ltd., Riverside, Ont., awarded general contract for the construction of a 4 story, 50 x 120 ft. liquor blending plant to J. W. Strain, 227 Victoria Rd., Walkerville, Ont. Estimated cost $100,000.

Lye Kettle House — Lever Bros. Co., Cambridge, Mass., is having plans prepared for the construction of lye kettle house. C. T. Main Co., 201 Devonshire St., Boston, Mass., is engineer.

Nickel Refining Plant — International Nickel Co., J. Agnew, Mgr., Port Colborne, Cnt., is having plans prepared for the construction of a nickel refinery plant. Estimated cost $50,000. Complete equipment will be required.

Oil Shale Plant—Shale Oil Machinery & Supply Co., Denham Bldg., Denver, Colo., plans the construction of an oil shale plant on Colorado-Utah state line.

Ore Smelting Plant—Republican Mining & Metal Co. Ltd., Wadley, San Luis Potosi, Mexico, is having surveys made for the construction of an ore smelting plant at Brownsville, Tex. Estimated cost $100,000.

Paint Factory—Rinshed Mason Co., 5935 Milford Ave., Detroit, Mich., awarded contract for the construction of a 2 story, 77 x 100 ft. paint factory to Corrick Bros., 507 Owen Bldg., Detroit. Estimated cost $50,000.

Paint Factory—Steelcote Mfg. Co., 3418 Gratiot St., St. Louis, Mo., awarded contract for the construction of a 2 story, 60 x 100 ft. addition to factory for the manufacture of paints, waterproofing materials, enamel stains and allied lines to J. H. Bright Contracting Bldg. Co., 1821 Arcade Bldg., St. Louis. Estimated cost $40,000.

Paint and Oil Factory—American Oil & Paint Co., C. D. Rogers, Pres., 5005 Euclid Ave., Cleveland, O., awarded contract for a 2 story, 50 x 110 ft. paint and oil factory on Harvard Ave. to G. W. Pelton Co., 2448 Euclid Blvd., Cleveland Heights. Estimated cost $40,000.

Paper Factory—Commercial Papers Ltd, 381 Adelaide St. W., Toronto, Ont., is having plans prepared for the construction of a factory on King St. E. Chapman & Oxley, Sterling Tower, Toronto, are architects.

Paper Mill—Consolidated Paper Co., Elm St., Monroe, Mich., will soon receive bids for the construction of a warehouse in connection with paper mill. Estimated cost $200,000. F. F. Wernert, Toledo, O., is architect.

Paper Mill—Hinde & Dauch Paper Co., W. W. Forsman, Mgr., 5110 Penrose St., St. Louis, Mo., awarded contract for a 1 story, 79 x 468 ft. factory to Otto Randolph Inc., 53 West Jackson Blvd., Chicago, Ill. Estimated cost $125,000.

Paper Mill—International Paper Co., 100 East 42nd St., New York, plans the construction of a large paper mill between Mobile and Marengo counties, Alabama. Work will be done by day labor.

Paper Mill—James Maclaren Lumber Co., Buckingham, Que., awarded contract for the construction of a 250 ton paper, also 75 ton sulphite mill at Buckingham Junction to Foundation Co. of Canada, Ltd., 746 Sherbrooke Ave., W., Montreal, Que. Estimated cost $6,000,000.

Paper Mill Addition—Inter-Lake Tissue Mills, Merritton, Ont., awarded contract for a 3 story addition to paper mill on Merritt St. to W. J. Trimble, 73 Adelaide St. W., Toronto. Estimated cost $75,000.

Phosphoric Acid Plant — American Cyanamid Co., 535 5th Ave., New York, N. Y., has acquired a site and plans the construction of a phosphoric acid plant at Tampa, Fla. Estimated cost $1,500,000. Private plans.

Pulp Mill—International Paper Co., 100 East 42nd St., New York, N. Y., plans the construction of a pulp mill near Pinopolis, S. C., in connection with hydro-electric development on Santee and Cooper Rivers being erected by the Columbia Railway & Navigation Co., a subsidiary. Estimated cost of mill $3,000,000, and power development $1,000,000.

Radio Tube Factory—Sonatron Tube Co., 57 State St., Newark, N. J., is having preliminary plans prepared for a 6 story, 68 x 120 ft. radio tube factory at 78-82 8th Ave. Estimated cost $175,000. Siegler & Greenberg, 164 Market St., Newark, are architects.

Rayon Plant—Industrial Rayon Corp., F. C. Niederhauser, V. Pres., W. 98th and Walford Sts., Cleveland, O., had plans prepared for a 1 story, 42 x 256 ft. addition to rayon plant. Estimated cost $60,000. Christian, Schwarzenberg & Gaede, 1900 Euclid Bldg., Cleveland, are architects.

Refinery (Copper)—Phelps-Dodge Corp., 99 John St., New York, N. Y., awarded contract for structural steel for the construction of a copper refinery at El Paso, Tex. Estimated cost $3,000,000.

Refinery (Gasoline) and Compression Plant — Phillips Petroleum Co., Bartlesville, Okla., plans the construction of a plant in Noodle Creek oil fields, Jones County, Tex. Estimated cost $75,000.

Refinery (Oil) — Globe Refining Co., Cushing, Okla., plans addition to oil refinery including two 2,000 bbl. high pressure stills. Estimated cost $450,000. Private plans.

Refinery (Oil)—Seminole Refining Co., Wewoka, Okla., is having plans prepared for the construction of an oil refinery. Estimated cost $75,000. Private plans.

Refinery (Sugar) Addition — National Sugar Refining Co. of New Jersey, 129 Front St., Long Island City, N. Y., awarded contract for addition to sugar refinery at 54th Ave. and Second St. to E. F. Warwick, Crescent Plaza Bldg., Long Island City, N. Y. Estimated cost $40,000.

Refinery (Sugar)—Western Sugar Refining Co., 2 Pine St., San Francisco, Calif., is having plans prepared for a 1 and 2 story, 140 x 320 ft. warehouse for sugar refinery at 23rd St. Estimated cost $200,000. H. J. Brunnier, Sharon Bldg., San Francisco, is engineer.

Rubber Factory—B. F. Goodrich Rubber Co., South Main St., Akron, O., is having plans prepared for the construction of a 2 and 3 story, 160 x 190 and 160 x 240 ft. factory at Thomasville, Ga. Robert & Co., 708 Bona Allen Bldg., Atlanta, Ga., are architects and engineers.

Rubber Factory—Goodyear Tire & Rubber Co., 1144 East Market St., Akron, O., awarded contract for the construction of a rubber factory at Gaston, Ala., to A. K. Adams, 542 East Market St., Atlanta, Ga. Estimated cost $750,000.

Rubber Factory—Samson Tire & Rubber Corp., 733 East 8th St., Los Angeles, awarded contract for the construction of a 1 and 4 story, 265 x 350 ft. factory to include boiler plant, pump house, etc., to McNeil Co., 5860 Avalon Blvd., Los Angeles.

Rubber Factory Addition—Joseph Stokes Rubber Co., P. O. Gunkel, Mgr., John St., Welland, Cnt., awarded contract for 50 x 200 ft. addition to factory for the manufacture of battery containers to G. C. Scott, 262 North Main St., Welland. Estimated cost including equipment $50,000.

Soap Factory — Procter & Gamble, Gwynne Bldg., Cinrinnati, O., will soon receive bids for the construction of a soap factory at Baltimore, Md. Estimated co... including equipment $5,000,000. H. Ma... ley, 5 East 53rd St., New York, N. Y., architect.

Soda Factory—Bieber Polar Soda ... 111 Summer St., Worcester, Mass., awa... contract for a 1 story, 75 x 100 ft. addi... and alterations to soda factory to Ha... & McCarthy, 32 Dean St., Worcester. Esti... mated cost $40,000.

Sulphtie Mill—International Paper Co., 100 East 42nd St., New York, N. Y., plans the construction of a bleaching sulphite mill, 100 ton daily capacity at Morrisons Cove, N. B.

Sulphuric Acid Plant—Czark Chemical Co., Ritz Bldg., Tulsa, Okla., plans the construction of a sulphuric acid plant, 1,000 ton per month capacity, at Pecos, Tex. Estimated cost $250,000.

Varnish and Lacquer Factory—Berry Bros., 211 Leib St., Detroit, Mich., awarded contract for the construction of a 4 story factory to C. O. Barton Co., 1900 East Jefferson Ave., Detroit. Estimated cost $100,000.

Wool Products Plant — Banner Rock Products Co., Alexandria, Ind., subsidiary of Johns-Manville Co., Madison Ave. and 41st St., New York, N. Y., plans the construction of a 2 story, 160 x 200 ft. plant for the manufacture of mineral wool products used in refrigeration plants and iceless refrigerators at Alexandria. Estimated cost $100,000. Work will be done by day labor.